DOCUMENT RESUME

ED 356 970 SE 053 478

AUTHOR	Thirunarayanan, M. O., Ed.
TITLE	Handbook of Science, Technology, and Society. Volume II: STS in Action in the Classroom.
INSTITUTION	Arizona State Univ., Tempe. Coll. of Education.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	92
CONTRACT	NSF-TPE-8955254
NOTE	345p.; Second volume of a two-volume set. A product of the Urban, Minority, Middle School STS Teacher/Community Project.
AVAILABLE FROM	STS-Project-FEE, College of Education, Arizona State University, Tempe, AZ 85287-0911.
PUB TYPE	Guides - Classroom Use - Instructional Materials (For Learner) (051) -- Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Citizenship Education; Class Activities; Critical Thinking; Economics; Elementary Secondary Education; Environmental Education; Global Approach; Integrated Activities; Interdisciplinary Approach; Learning Activities; Lesson Plans; *Science and Society; Science Education; *Teaching Methods; *Units of Study
IDENTIFIERS	Environmental Issues; *Environmental Problems; Science Technology and Society Courses

ABSTRACT

This publication is the culmination of the efforts of many teachers involved in a 1- to 3-year Arizona Science, Technology, and Society (STS) project. It contains 34 lesson plans or units of study these teachers modified or created to integrate STS topics, issues, and problems. The major thrust of the activities and units of study cited is to help teachers prepare elementary and secondary students for roles as empowered citizens in a society influenced by advances in science and technology. Topics include: biodiversity, the earth summit '92, an exploratory problem solving activity, energy and economics, parent participation, hunger, using the learning spiral method, communicable diseases, integrated teaching approach, history, language arts, life science without animal dissection, computers in the classroom, how to design a satellite, distances and time, school gardening, schoolwide cooperative programming, earthquake waves, space exploration, soil, global awareness, STS media search (utilizing a multi-age integrative teaching technique), global environmental problems, energy conservation, social action, weather and the water cycle, economics and industry, future studies, and wind erosion. (MCO)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED356970

THINK AND ACT

MAKE AN IMPACT!

HANDBOOK OF SCIENCE, TECHNOLOGY AND SOCIETY

VOLUME II

STS IN ACTION IN THE CLASSROOM

Edited by M. O. Thirunarayanan, Ph.D.

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☒ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN **OTHER THAN PAPER COPY** HAS BEEN GRANTED BY

M. O. Thirunarayanan

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SE 053 478

BEST COPY AVAILABLE

HANDBOOK OF SCIENCE, TECHNOLOGY AND SOCIETY

VOLUME II
STS IN ACTION IN THE CLASSROOM

Edited by M.O. Thirunarayanan, Ph.D.

URBAN, MINORITY, MIDDLE SCHOOL STS
TEACHER/COMMUNITY ENHANCEMENT PROJECT
COLLEGE OF EDUCATION
ARIZONA STATE UNIVERSITY

1992

© 1992 by the Arizona Board of Regents on and behalf of the Arizona State University and its Urban, Minority, Middle School STS Teacher/Community Enhancement Project.

The title of this handbook was changed from 'Handbook of STS Resources," to 'Handbook of Science, Technology and Society." This change was made to ensure that the title of the two-volume handbook accurately reflects the nature of its contents.

This material is based upon work supported by the National Science Foundation under Grant No. TPE-8955254. The Government has certain rights in this material. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Dr. Frederick A. Staley is the Director of the Urban, Minority, Middle School STS Teacher/Community Enhancement Project.

All parts of this volume of the handbook may be freely copied for classroom use.

STS Project-FEE
College of Education
Arizona State University
Tempe, AZ 85287-0911
Phone: (602) 965-3133

TABLE OF CONTENTS

TITLE	PAGE
Acknowledgements	v
Foreword	vi
Detailed Summaries of Articles	vii
Biodiversity	1
Earth Summit '92	9
Egg-stasy: An Exploratory Problem Solving Activity	20
Energy Explorations	22
Expert Students Teach Science to Novice Parents	34
Food for Thought	52
Go Fly a Kite!	66
Health Choices for Life	71
Hide and Go Seek	91
Historical Artifacts	109
It Was the Best of Times, It Was the Worst of Times	112
Language Arts and STS	115
The Learning Spiral - Try It, You'll Like It	120
Life Science Without Animal Dissection	125
MAC ATTACK! or There's a Computer in My Classroom and I've Heard They Byte	135
Payload to Mars	138

Relationships in Space 141
A School Garden: An STS Project 148
Schoolwide Cooperative Programming 159
Shake and Quake 164
Should We Explore Our Solar System? 176
So What's the Dirt on the States? 180
STS Global Awareness - The Good Life 183
STS Media Search 202
STS Star Bright 207
Survival of Our Planet 230
Thirty Day Energy Conservation Calendar 270
To Act or Not to Act: Social Action in the Classroom 281
WANTED: Social Unrest and Hostile Takeovers in the Classroom 297
Weather and the Water Cycle 300
We'll Name It Later 304
What Does Your Future Hold? 313
Wind Erosion 317

ACKNOWLEDGMENTS

A number of people were involved in the creation of this volume of the Handbook of Science, Technology and Society. The teachers who wrote the articles which appear in this volume deserve most of the credit for the creation of this handbook. I would like to thank them all for the time and effort they put in this summer to make this handbook a reality.

Once the articles were written, Linda Begalman, olivia free-woman and Rhonda Gross read several drafts of the articles and offered numerous editorial suggestions. I want to thank them for their suggestions. Doug Freeman, who helped me incorporate the graphics into the handbook, deserves a lot of credit for his patience. Vanessa Salas deserves special mention for creating the "Detailed Summaries of Articles." Vicki Hester of the STS Project helped create quite a few graphics for this document, and I thank her for her help.

Last but not the least, I would like to thank Dr. Staley for letting me take on this project as well as encouraging me to complete it.

M.O. Thirunarayanan
Special Lecturer
STS Project
Arizona State University

FOREWORD

Science, Technology and Society began as a grassroots effort in the United States to provide a more relevant and meaningful curriculum for students. In Arizona this effort came about largely because of the efforts of two STS Projects founded by the National Science Foundation, Salt River Project, and Arizona State University. Teachers from rural, urban, and suburban elementary and unified school districts in and around Phoenix were involved in this local effort. They changed their approaches to instruction, modified existing curriculum with STS topics, issues and problems, united their efforts with parent, community and business partners, and created new lessons and units to better prepare their students for roles as empowered citizens in a society influenced by advances in science and technology.

This STS in Action in the Classroom volume of the Handbook of Science, Technology and Society was written by several of the Phoenix area middle school teachers who were involved in the STS Project. The teachers all had one to three years experience with STS. They devoted several hours interacting with one another during the summer in order to put into words those things which worked for them while engaging their students in STS activities, lessons, and units. This Volume is for other teachers anywhere in the world who wish to begin or expand the STS movement in their own classrooms, schools, and communities.

M. O. Thirunarayanan (Thiru), an integral person in the STS Project in Arizona, had the vision of a handbook series to provide both theoretical and practical ideas about STS for educators. He nurtured this project with support and encouragement for the authors and spent many long hours of time editing, formatting, printing and coordinating the publication of this document.

We encourage you to try some of the ideas in this Volume. Then provide us with your written feedback and suggestions. Our hope is to produce another volume like this one with different articles describing things that have worked with middle school students in STS classrooms. You may even have an idea for an article you would like included.

Frederick A. Staley
STS Project Director
Arizona State University

DETAILED SUMMARIES OF ARTICLES

BIODIVERSITY

(Grades 7-12)

By Sandra Israel and Linda Begalman

(Contains two activities that were designed to familiarize the students with the concept of biodiversity and to help them realize the impact of the loss of biodiversity on our planet. This article also supplies the teacher with very detailed information about biodiversity. These activities integrate science and social studies.)

EARTH SUMMIT '92

(Grades 4-8)

By Linda Begalman and Sandra Israel

(Contains week long activities that will help students develop an awareness of the Earth Summit and environmental issues impacting the planet, analyze reasons for cooperation and non-cooperation and to generate ideas for improving the situation of non-cooperation.The activities include step by step instructions and game grids. These activities integrate science and social studies.)

EGG-STASY: AN EXPLORATORY PROBLEM-SOLVING ACTIVITY

(Grades 3-7)

By Teresa Olson

(Contains a two week long exploratory problem solving activity. This activity requires the students to create an egg vehicle that would allow an egg to be dropped from a certain height safely. This activity integrates science, technology, math and language.)

ENERGY EXPLORATIONS

(Grades 5-8)

By Teresa Olson

(Contains two to nine-week long activities that are designed to impart concern about our current energy situation, knowledge of our current energy practices and hopeful solutions to some of our energy problems. Students will be exploring the nature of energy, different forms of energy, methods by which energy is supplied to your geographic area,kinds and amounts of energy that are used in your area and the cost of the energy you use in terms of both economics and the environment. These activities integrate science and technology.)

EXPERT STUDENTS TEACH SCIENCE TO NOVICE PARENTS

(Grades 4-8)

By Gerald Damion, Douglas Freeman and Lynn Piwowarczyk

(Provides ideas for conducting a science activity night for parents. These activities allow parents and family members to participate in energy oriented experiments by experiencing the same learning process as their children. These processes include the establishment of cooperative learning between parent and child, the use of the scientific method and the development of more effective communication skills. These activities integrate science, technology and social studies.)

FOOD FOR THOUGHT

(Grades 6-12)

By Linda Begalman and Sandra Israel

(Contains a three day lesson plan that helps to focus student attention on the many issues surrounding hunger. The topics for these activities are the inequities in the distribution of food, using an inter-relationship matrix and the need for cooperation to solve the problem of world hunger. These activities integrate science and social studies.)

GO FLY A KITE!

(Grades 5-8)

By Rhonda Gross

(Contains a five week kite building activity using the learning spiral method. The activity includes a day to day lesson plan. A good introduction to the learning spiral method. This activity integrates science and technology.)

HEALTH CHOICES FOR LIFE

(Grades 5-8)

By Rhonda Gross and Teresa Olson

(Includes a two week lesson plan that contains twelve usable activities about the transmission, prevention, and causes of communicable diseases.These activities include making frozen yogurt, an experiment on soil bacteria, inoculate a culture dish, researching bacterial food poisoners, role playing and conducting an experiment concerning the effects of antiseptics and antibiotics on bacteria. All of these activities integrate science, math and language.)

HIDE AND GO SEEK

(Grades 4-8)

By Gerald Dameon, Douglas Freeman and Lynn Piwowarczyk

(Contains activities that may take one week to nine weeks long. These activities integrate a variety of skills into one event. This article provides eight different example activities complete with worksheets. These activities integrate science, social studies, math and language.)

HISTORICAL ARTIFACTS

(Grades 6-7)

By Teresa Olson

(Contains a four to eight week long project on researching the history of the students' school or town. This activity includes researching skills, cooperative learning and language skills. This activity integrates science, technology and social studies.)

IT WAS THE BEST OF TIMES, IT WAS THE WORST OF TIMES

(Grades 4-8)

By Vanessa Salas

(Contains a five week lesson plan that includes identifying the major turning points in American history through the 1900's and the 1980's.This activity has the students involved in art, music and dancing. This activity will allow students to work in cooperative learning groups, use problem solving, decision making and social skills. This activities integrates social studies, science and language.)

LANGUAGE ARTS AND STS

By Teresa Olson

(Grades 6-7)

(Provides suggestions for integrating newspapers into the classroom to teach language arts skills.)

THE LEARNING SPIRAL - TRY IT, YOU'LL LIKE IT

(Grades 5-8)

By Cahal O'Coileain

(Contains two lessons that incorporate the learning spiral technique. These activities include step by step instructions that would be very beneficial to a teacher that is learning to use the learning spiral technique.)

LIFE SCIENCE WITHOUT ANIMAL DISSECTION

(Grades 4-8)

By Rhonda Gross

(Includes month long activities, suggestions and resources that will help fulfill course dissection objectives. Many of the activities include lab worksheets and use a variety of materials for dissection such as jello, owl pellets, clay and flowers. These activities integrate science and technology.)

MAC ATTACK! OR THERE'S A COMPUTER IN MY CLASSROOM AND AND I'VE HEARD THEY BYTE

(For Teachers)
By olivia free-woman
(This humorous article is an introduction on how teachers can use a computer in their classroom.It also includes some suggestions on how to get students involved in using a classroom computer.)

PAYLOAD TO MARS

(Grades 5-8)

By Rhonda Gross

(Contains a three week lesson plan on how to design and use a satellite. It also includes satellite organizations that teachers may contact for additional information. These activities integrate science and technology.)

RELATIONSHIPS IN SPACE

(Grades 5-8)

By Rhonda Gross

(Contains month long activities which express distances and time using scientific notation, determines planet size ratios using a chart and arranges planets in order according to diameter. These activities include step by step instructions and diagrams. This article integrates science, and math.)

A SCHOOL GARDEN: AN STS PROJECT

(Grades 5-8)

By Cahal O'Coileain

(Contains a year long school garden project complete with instructions and suggestions on the best way to develop a school garden in your school. This article also contains a two day lesson plan that provides for the following strategies: interdisciplinary instruction invoving both math and science, team teaching invoving math and science, students and teachers, peer coaching and mentoring, spiral learning, cooperative learning and environmental awareness and action)

SCHOOLWIDE COOPERATIVE PROGRAMMING

(Grades 4-8)

By Susan Perez and Vanessa Salas

(Includes activities that incorporate a school-wide, cooperative program that could continue throughout the school year. The activities include making a school pond, starting a recycling patrol and beginning your own school garden. These activities integrate science and social issues.)

SHAKE AND QUAKE

(Grades 7-8)

By olivia free-woman

(Contains a learning spiral activity that demonstrates the impact that different types of earthquake waves have on buildings. This activity includes step by step instructions and integrates science and technology.)

SHOULD WE EXPLORE OUR SOLAR SYSTEM?

(Grades 5-8)

By Rhonda Gross

(Includes a two week lesson plan on how to evaluate the cost of space exploration in relationship to the yearly national budget, brainstorm the benefits of space exploration and how to achieve a class wide consensus concerning the importance of space exploration compared with other societal needs. These activities integrate science, technology, math and social studies.)

SO WHAT'S THE DIRT ON THE STATES?

(Grades 5-8)

By Rhonda Gross

(Contains a month long lesson plan with some very interesting and integrated activities. These activities will allow students to write friendly letters and formal business letters, present a written or oral report, participate in a simulated "town hall meeting" concerning state environmental issues and investigate soil samples from all over the country. These activities integrate language arts, social studies and science.)

STS AWARENESS - THE GOOD LIFE

(Grades 7-12)

By Teresa Olson

(Contains a two to nine week long cross curriculum unit which promotes global awareness among students through the use of social and economic indicators for different countries. This unit incorporates skills such as study and reflection, decision making, taking responsible action and integrating specific subject matter to broader considerations of science, technology, and society.)

STS MEDIA SEARCH

(Grades 4-8)

By Teresa Olson

(Contains a multi-age integrative technique with some daily lesson plan examples. This activity can be used to introduce students to the many strands od STS instruction, and their role as information gatherers and reviewers. This technique integrates science and technology.)

STS STAR BRIGHT

(Grades 6-12)

By Sandra Israel and Linda Begalman

(Consists of two-week long activities complete with materials, vocabulary worksheets and objectives. The purpose of this activity is to help students become better informed about the environmental problems that are facing the inhabitants of our planet. The main activity in this article is an interactive skit, providing a hands-on approach regarding environmental issues. The setting for this skit is in the future, on a space ship heading towards an imaginary planet. The problems facing the inhabitants of the imaginary planet are analagous to many of the problems facing the inhabitants of our own planet Earth. These activities integrate science, technology and language.)

SURVIVAL OF OUR PLANET

(Grades 4-8)

By Vanessa Salas and Susan Perez

(Includes activities that deal with some major environmental problems, such as acid rain, air and water pollution, endangered species, greenhouse effect and the ozone hole. These activities include different experiments and an environmental trivia game and may take four weeks to complete. These activities integrate science, social studies and language.)

THIRTY DAY ENERGY CONSERVATION CALENDAR

(Grades 5-8)

By Vanessa Salas and Rhonda Gross

(Contains a thirty day energy conservation calendar which includes daily energy conserving experiments or activities. This conservation calendar integrates science, social studies and language.)

TO ACT OR NOT TO ACT: SOCIAL ACTION IN THE CLASSROOM

(Grades 7-8)

By olivia free-woman

(Contains a lesson plan on how students can take social action as a classroom project on an environmental issue. This activity includes examples and instructions on how to start this classroom project. This project integrates science, technology and social studies.)

WANTED: SOCIAL UNREST AND HOSTILE TAKEOVERS IN THE CLASSROOM

(Grades 7-8)

By olivia free-woman

(Contains a month long activity that uses ecomic systems in the classroom to motivate students to take social action. The students will fill out applications for an international conglomerate, give out pay checks, pay rent and utilities and balance a checkbook. They will also be role playing bankers and managers and dealing with salary cuts and employee cutbacks. This activity integrates math, social studies and language.)

WEATHER AND THE WATER CYCLE

(Grades 4-6)

By Teresa Olson and Valerie Grimes

(Contains a unit on weather and the water cycle. in which sudents participate in a dance of the moving molecules, explore myths about the weather, build a weather testing and recording station and studied rainbows.These activities integrate language arts,mathematics, art, field-trips and career awareness.)

WE'LL NAME IT LATER

(Grades 6-8)

By Jerry Dameon, Douglas Freeman& Lynn Piwowarczyk

(Creates a realistic teaching activity, whereby problems bring into play several topics of instruction. Students utilize modern technology to solve a problem. They gain a better understanding of the complexity of economics and the competitiveness of industry. Students will be video taping and dealing with marketing and advertising. This activity integrates science, technology, math and language.)

WHAT DOES YOUR FUTURE HOLD?

(Grades 4-8)

By Vanessa Salas

(Contains a four week activity about what the future may be like. The students will be researching, making predictions and doing some creative writing. This article also includes a suggested list of resources for the future unit. This activity integrates science, technology and language.)

WIND EROSION

(Grades K-6)

By Rhonda Gross

(Contains unique activities that show wind erosion, stripmining techniques and hunting for silver in geological jello. These activities are for all grade levels and provide students with a very interesting way of learning about environmental problems.These activities include a list of materials needed and step by step instructions and diagrams. These activities integrate science, math and language.)

BIODIVERSITY

(Grades 7-12)

By Sandra Israel & Linda Begalman

TO THE TEACHER

As part of the STS movement, educators need to encourage their students to become responsible citizens. Students need to be made aware of our planet's ecosystems and our responsibility to help maintain these systems. Our very survival depends on the preservation and maintenance of these precious ecosystems.

The following lesson was designed to familiarize the students with the concept of biodiversity and to help them realize the impact of the loss of biodiversity on our planet. The lesson was designed for students in grades 7-12. Teachers in other grades can easily modify this lesson to make it suitable for their students.

BIODIVERSITY TREATY

In June 1992, over 100 leaders from various nations met in Rio de Janeiro at the Earth Summit. The goal of this United Nations sponsored conference was to address the environmental issues impacting the planet. The nations signed various treaties to try and meet the environmental challenges of the 21st century.

One treaty was the Biodiversity Treaty. The main goal of this treaty was to decrease the loss of the world's endangered species. It has been predicted that as much as 20 per cent of the world's species may be extinct by the year 2020. At least half of these doomed species live in the world's tropical forests. These tropical forests are disappearing because of logging and livestock production.

The Biodiversity Treaty was designed to allow the developing nations a financial interest in the preservation of their native species and forests. The treaty is based on the philosophy that the poorer nations should share in the monetary gain obtained from products derived from their indigenous plants and animals. This raised the issue of the ownership and control of genetic information. Currently, the drugs and/or products obtained from plants and animals belong to the individual or company who developed them. The developing nations wanted the Biodiversity Treaty to include a provision that would make all genetic materials the sovereign resource or the property of the countries where these resources originated from. Those nations would then control access to their genetic resources and collect royalties from their use. The United States wanted to protect the intellectual property rights of those individuals and companies who developed drugs and products from genetic resources found naturally in other countries.

The final version of the Biodiversity Treaty was signed by representatives of 153 nations. The governments of each of these 153 nations must approve the treaty by June of

1993 in order for it to be put into effect. While agreeing with the basic principles of preserving species and ecosystems, the United States refused to sign this treaty on the basis that it threatened to slow down the development of biotechnology and did not provide for protection of ideas and intellectual property rights.

BIODIVERSITY

A major issue faced by the delegates at the Earth Summit is the loss of biological diversity from the Earth. Biological diversity (often shortened to biodiversity) is the total variety of life on the planet. Biodiversity is identified, studied, and analyzed at three distinct levels:

1. the variety of ecosystems
2. the variety of species
3. the genetic variety within species

Each level influences and is influenced by the other two levels.

ECOSYSTEM VARIETY

An ecosystem is the complex relationship between a community and the environment, functioning as a natural ecological unit. Examples of ecosystems include: forests, wetlands, coastal waters, grass prairies, deserts, etc. The deterioration of whole ecosystems contributes to a significant loss of biodiversity on Earth.

Tropical forests are a type of ecosystem that have experienced great deterioration. The planet's tropical forests are currently about one-half of their original size. Estimates for the rate of deforestation range from a low of 4 million acres to a high of 42 million acres per year. The low estimate of 4 million acres is the equivalent to the loss of a tropical forest the size of the state of Connecticut every year. The high estimate equates to the loss of a tropical forest the size of the state of Washington in a single year! In certain areas of the world, (El Salvador, Ghana, Western Ecuador, Haiti, Nigeria, and others) these forests have virtually vanished! Brazil has more tropical forest than any other nation. While massive deforestation is still occurring, it has slowed considerably, leaving nearly 90% of the original groves still standing. However, more than 95% of Brazil's Atlantic coastal forests and southern coniferous forests have been destroyed. This is due to logging and the raising of livestock.

There are other types of ecosystems that have nearly disappeared from the earth. These vanishing ecosystems include: the tall grass prairies of North America, the great cedar groves of Lebanon, and the old-growth hardwood temperate forests of Europe and North America. These temperate forests are likely a more endangered ecosystem than the tropical forests. At one time, there were more than 76.6 million acres of temperate forest land on the earth. Approximately 44% now remains. In the mainland U.S., more than 90% of the old-growth hardwood forests have been destroyed!

Another endangered ecosystem is the wetlands. Like forests, wetlands are areas rich in natural biological diversity. They are also very productive ecosystems. Wetlands help regulate water flows, remove pollutants and sediments, and provide habitat for fish, waterfowl, and various other species. There has been a significant loss of the planet's wetlands. In Australia, New Zealand, and California, less than 10% of the original wetlands now exist.

Mangrove swamp forests are one of the most valuable types of wetlands. Coastal wetlands, including mangrove forests, comprise a portion of an interdependent labyrinth of coastal habitats that protect the inland ecosystems from the forces of the seas and oceans. They also protect the off-shore ecosystems (such as the coral reefs) from land-based pollution. However, mangrove forests are one of the most endangered ecosystems. Ecuador has lost nearly half of its mangrove forests. India, Pakistan, and Thailand have lost at least 75% of their mangrove forests. The preservation of ecosystems is crucial to halt the loss of this planet's biodiversity. The protection of ecosystems is the single most efficient vehicle to preserve the biodiversity of the earth. The deterioration of whole ecosystems is the major cause of the present mass extinction of individual species.

SPECIES VARIETY

The most familiar type of biodiversity loss is the decline of species. A species is a group of entities that have common traits, are known by a common name and can reproduce in natural conditions. The majority of this decline occurs in the tropical forests. The tropical forests are home to more than one-half of the species found on the earth. At this point in time, scientists have identified over 1.4 million species on our planet. However, scientists surmise that there are between 10 million and 80 million more species. Most of these unidentified species live in the unexplored regions of the tropical forests. Still, before scientists can further investigate them, many of these undiscovered species are destroyed each day. If we use the low estimate of the yearly rate of deforestation of the tropical forests, this amounts to a projected loss of over fifty thousand species per year. Most of the species that are becoming extinct are invertebrates of the tropical forests. Two-thirds of the world's plants are found in the tropical forests and many of these are threatened with extinction. The landscapes of southern Africa house the world's concentration of threatened plants. It has been estimated that four-fifths of these threatened plants are found no place else on this planet.

This decline in species does not occur only in the tropical forests. The United States houses over three thousand species that are in danger of extinction. There is also a worldwide decline in the number of amphibians. It is projected that by the year 2020, 10 to 20 per cent of all the world's species will be extinct.

At one time, it was thought that many species were irrelevant. One example of an "irrelevant" species was the dodo bird. It was later discovered that a particular species of tree depended on the dodo bird for germination, but once the dodo was gone, the trees eventually disappeared from the earth. As time goes on, it has been proven that each species is essential to the entire ecological system. Man is now learning that species once thought to be unimportant are actually vital to the ecosystem that sustains human life. Humans are extremely dependent on other species for existence. The protection of ecosystems is the single most effective way of preserving the biodiversity of species.

GENETIC VARIATION

Genetic variation refers to the range and assortment of traits within a species. The rate of loss of genetic variation within a species is likely greater than the extinction rate of the species. This loss of genetic variation is also termed genetic erosion. Genetic erosion is particularly great in food crops and related species of wild plants.

Traditionally, farmers used genetic diversity to increase crop production. They planted a large variety of different strains of the same crop species. However, in the past several decades, farmers have been using only a small assortment of crop species that are high-yielding varieties. While this has allowed for a substantial increase in food production, it has also caused the decimation of many local, traditional strains of the same crop species. These local strains could have been used in the development of high-yielding crops that would have been better suited to the local environments.

An example of the genetic erosion of rice occurred in India. In the past, the farmers in India planted approximately 30,000 different strains of rice. It is predicted that by the year 2005, most of India's rice fields will be planted in only 10 different strains. The major problem of having so many crops genetically similar, is that this similarity also makes them vulnerable to the same pests and diseases. In 1991, Brazil experienced a large outbreak of citrus infections, including citrus cancer. Brazil's orange trees were very similar genetically, and were especially vulnerable to these particular infections. This resulted in the destruction of most of Brazil's orange crop. If there had been a large genetic assortment of orange trees, the crop loss could have been considerably less.

Genetic erosion is not exclusive to the plant kingdom. The loss of genetic diversity is also a serious problem with animals. One example of this type of genetic erosion has occurred in North America. More than 100 major populations of steelhead fish and salmon have disappeared from our west coast. Also, fish produced in hatcheries are now replacing the wild varieties. Approximately three-fourths of the fish in the Columbia River basin are now produced in hatcheries. The loss of wild populations of fish mean that the world is losing traits and characteristics that are unique to those populations.

ACTIVITY - ENDANGERED SPECIES OF THE WORLD

Objectives:

Students will be able to . . .

1. Locate and identify the world's land masses.
2. Identify various endangered species around world.

Materials:

(a) Butcher paper
(b) Atlas
(c) Pencil
(d) Scissors
(e) Crayons
(f) 3 x 5 cards
(g) Chart of Continents and Endangered Species
(h) Yarn
(i) Rulers
(j) Magazines

Procedure:

1. Divide the class into seven groups.
2. Have a representative from each group choose the name of a continent out of a hat.
3. Have the groups draw their continents onto the butcher paper. Using the scale in the atlas increase the size of the continent three times (each group's map will be proportionate to the other group's maps).
4. Each group will then research animals and plants indigenous to their continent. Given the "Chart of Continents and Endangered Species," they will also find out which species are considered endangered (cut apart the chart and give each group only the needed information for their particular continent).
5. Have each group write the information concerning the endangered species on 3 x 5 cards and attach their cards to the continents with yarn.
6. Have the groups illustrate these species on their continents. They may either draw or use illustrations from the magazines.
7. Have each group include a legend and scale on their map.

Evaluation:

- Students will share their information with other members of the class.

CHART OF CONTINENTS AND ENDANGERED SPECIES

NORTH AMERICA

- California Condor
- Mountain Lion
- Florida Panther
- Polar Bears
- Grey Wolf
- Spotted Owl
- Grizzly Bear
- Alligator
- Bald Eagle

SOUTH AMERICA

- Rhea
- Woolly Spider Monkey
- Vicuna
- Brown Howler Monkey
- Jaguar
- Sloth
- Chinchilla
- Ocelot
- Guadalupe Seal
- Otter

EUROPE

- Dalmatian Pelican
- Salmon
- Otter

ASIA

- Leopard Tiger
- Siberian Tiger
- Orangutans
- Giant Panda
- Elephant
- Sumatra Tiger

AFRICA

- African Elephant
- Cheetah
- Lemurs
- Leopard
- Black Rhinoceros
- Mountain Gorilla
- Madagascar Sea Eagle
- Chimpanzee

AUSTRALIA

- Wallaby
- Kangaroo
- Platypus
- Green Sea Turtle

ANTARCTICA

- Humpback Whale
- Right Whale
- Seal
- Blue Whale
- Bowhead Whale
- Penguin

INTERDEPENDENCY LAP SIT

Main Idea:

- "Life forms support and depend on each other."

Objectives:

Students will . . .

1. Define the term "interdependency"
2. Describe how life forms in an ecosystem share an interdependent relationship

Materials:

(a) Sentence strips
(b) Markers
(c) Paper clips

(**NOTE TO THE TEACHER**: Prior to conducting this activity, prepare the "species crowns" by writing the following words on sentence strips: insects, plants, birds, amphibians, reptiles, mammals, fish, microbes. Paper clip the ends of each sentence strip together, forming a "crown" or "headband". Put them aside for use later in the lesson. Also, make sure that you have cleared an area of the room large enough for at least eight students to perform a lap sit.)

Procedure:

1. Write the following words on the chalkboard: microbes, plants, insects, birds, amphibians, reptiles, mammals, fish.
2. Have the class discuss the meaning of each word and how the words are related.
3. Ask for eight student volunteers. Hand out the "species" crowns" and have the students place them on their heads.
4. Have these students form a circle (make sure that there is sufficient space for this activity!), standing shoulder to shoulder, facing the center.
5. Tell the students to turn toward their right.
6. Now have the students take one step sideways toward the center of the circle. The students should now be standing quite close together, and looking at the back of the head of the student in front of him/her.
7. Tell the students to place their hands on the waist of the student in front of them.
8. At the count of three, tell the students to sit down on the knees of the student behind them, keeping their own knees together to support the person in front of them.
9. Once this lap sit circle is stable (it make take several attempts!), tell the class that this lap sit circle represents the interdependency of life forms in an ecosystem.
10. Tell the class, "Now, let's imagine that the insects were all killed by pesticides. What would happen to this lap sit circle if the insects suddenly left? "
11. Discuss with the class how the circle (and the ecosystem it represents) would collapse. Discuss the importance of the insects in an ecosystem (e.g. they pollinate the plants, are used as food by birds, fish, etc.).

12. Have the students in the lap sit circle return to their seats. Write the word "interdependent" on the chalkboard.
13. Ask the students: "The life forms in an ecosystem have an interdependent relationship. What does "interdependent" mean?"
14. Have the students brain storm the meaning of interdependent providing prompts and suggestions as needed.
15. Divide the students into small groups (3-4).
16. Using the suggestions on the board, have each group generate a definition for "interdependent".
17. Call on each group to read their definition.
18. Have the students check their definitions with the dictionary definition.

(**NOTE TO THE TEACHER**: The word "interdependent" may not appear in your students' dictionaries. It may be necessary to look up "inter" and "dependent" to arrive at a dictionary definition.)

Evaluation:

- At the conclusion of the activity, have each student write their own definition of "interdependent" and describe how life forms in an ecosystem share an "interdependent" relationship.

SUGGESTED ADDITIONAL READINGS

Abruscato, J. & Hassard, J. (1976) Small group learning. In Loving and Beyond. Science Teaching for the Humanistic Classroom. (pp. 26-27). Palisades, California, Goodyear Publishing Inc.
Adler, J. & Hager, M. (1992, June 1). Earth at the summit.Newsweek, 119 (22), 24-33
Aksyonov, V. (1992, June 9). Polluted by a land utopian idealogy. Arizona Republic, p. B9.
Begley, S. (1992, June 1). Is it apocalypse now? Newsweek, 119 (22), 36-42.
Easterbrook, G. (1992, June 1). A house of cards. Newsweek, 119 (22), 24-33.
Elmer-Dewitt, P. (1992, June 1). Rio: Coming together to save the earth. Time, 139 (22), 40-65.
French, H.F. (1992, May-June). From discord to accord. World Watch, 5 (3), 26-32.
Levine, M. D. & Meyers, S. (1992, Spring). The contribution of energy efficiency to sustainable development in developing countries. Natural Resources Forum, A United Nations Special Issue, 19-26.
O'Riordan, T. (1992, April). Editorial. Environment, 34(3), p.5.
O'Sullivan, E. (1992, May 29). Environment debate gathers momentum. Middle East Economic Digest, 36,(21), 4-5.
Ottinger, R.L. (1992, Spring) Energy and environmental challenges for developed and developing countries. Natural Resources Forum, A United Nations Special Issue, 11-17
Pastizzi-Ferencic, D. (1992, Spring). Natural resources andenvironmentally sound sustainable development. Natural Resources Forum. A United Nations Special Issue. 3-10.
Samuelson, R.J. (1992, June 1). Newsweek, 119 (22), 43.
Sigma Xi, & ICSU Secretariat. (1992, April). International. Environment, 34 (3). p.2.
Silverstein, K. (1992, June 15). Earth summit ends with high hopes. Arizona Republic, p. 1.
Third World-U.S. clash over saving the forest. (1992, June 11). Arizona Republic, p. B9.

EARTH SUMMIT '92

(Grades 4-8)

By Linda Begalman and Sandra Israel

TO THE TEACHER

The Earth Summit, formally known as the United Nations Conference on Environment and Development (UNCED), is an excellent example of the principles and philosophies of STS in action. This conference, the largest officially sponsored gathering on environmental issues, was held in Rio de Janeiro, Brazil in June 1992. Participants included heads of states, leaders of businesses, youth and educational groups, as well as representatives of indigenous peoples and grassroots organizations. The most difficult problem facing this conference was how to lay the foundation for a cooperative global partnership between the developing nations in the Southern Hemisphere, and the industrially developed nations in the Northern Hemisphere. This partnership must be based on the recognition of mutual needs and common interests.

The following lesson was designed to introduce students to the environmental issues impacting our planet and to help them realize the need for global cooperation to resolve these issues. The lesson was designed for grades 4 - 8, recognizing that teachers will make modifications appropriate for their particular grade level.

Objectives:

Students will . . .

1. Become aware of the Earth Summit and the environmental issues and problems impacting our planet
2. Become aware of the need for cooperation to resolve environmental issues and problems
3. Analyze reasons for cooperation and non-cooperation
4. Generate ideas for improving the situation of non-cooperation

Procedures:

1. Present information on the Earth Summit (teacher discretion as to individual or group reading)
2. Class discussion of terms and purposes of the Earth Summit
3. Cooperation-competition activities

EARTH SUMMIT '92 VOCABULARY TERMS

summit:

indigenous peoples:

grassroots organizations:

economic development:

foundation:

mutual:

biodiversity:

consumption:

decline:

EARTH SUMMIT: 1992

The Earth Summit, formally known as the United Nations Conference on Environment and Development (UNCED), was held in Rio de Janeiro, Brazil, in June 1992. Participants included heads of states, leaders of businesses, representatives of youth and educational groups, indigenous peoples, and grassroots organizations. The central premise of the conference was that environmental problems can no longer be solved at the local or national level, and that there cannot be economic development without environmental responsibility. There is no nation that can separate its fate from the fate of the planet as a whole. Failure to deal cooperatively and effectively with environmental issues such as: global warming, the loss of biodiversity, and human population growth, will mean that individuals, nations, and the planet will suffer.

These issues have divided the globe into two distinct groups. The North (the industrially developed nations) and the South (the developing nations). Most of the world's economic wealth lies in the Northern Hemisphere, controlled by a small minority of people. The developing nations in the Southern Hemisphere view the consumption patterns of the wealthy countries in the North as the source of the planet's environmental problems. The developing nations in the South want the developed nations in the North to protect them from the negative environmental consequences of industrialization. The estimated cost for this protection is US $125 billion per year!

The most difficult problem facing this conference is to determine how to lay the foundation for a global partnership between the developing nations in the Southern Hemisphere and the industrially developed nations in the Northern Hemisphere. This partnership must be based on a recognition of mutual needs and common interests. The goal is to build an environmentally secure world; a world in which individual and societal needs are met without destroying natural systems and resources. In order to reach this goal, a new economic order is required, an order which recognizes that high levels of consumption of natural resources, high population growth rates, and poverty are the driving forces behind the environmental decline of our planet.

This U.N. conference has provided an historic opportunity for citizens of the Earth to act collectively as a community of nations, cooperating to secure the planet's environment for present and future generations. The question remains: Can we learn to cooperate to resolve these critical issues?

COOPERATION-COMPETITION ACTIVITIES

COOPERATION SQUARES

This is an excellent activity to illustrate the need for group cooperation in solving a problem. Prior to conducting this activity, the square puzzle pieces must be prepared by cutting the shapes out of tag board, using the patterns provided. Place the different shaped puzzle pieces, by letter, in separate envelopes. Each envelope should contain three pieces. A complete set of five squares is required for each group of five students.

Procedure:

1. Divide the students into groups of five. If there are extra students, have them participate in the activity as observers, taking notes on the behaviors of the other students.
2. Give the following directions:
   "Each person will be given an envelope. In each envelope there are three puzzle pieces. The purpose of this activity is to form five squares so that each person in your group has a square the same size. In order to form the squares, you will need to exchange pieces with other members of your group. However, you may not talk. You must maintain complete silence. You may not point to a piece that you want, nor can you place a piece in another person's square. The only thing that you may do is give a piece to another player. You must hand the piece to the person you wish to give it to. The activity is over when each person in your group has a square that is the same size as everyone else's."

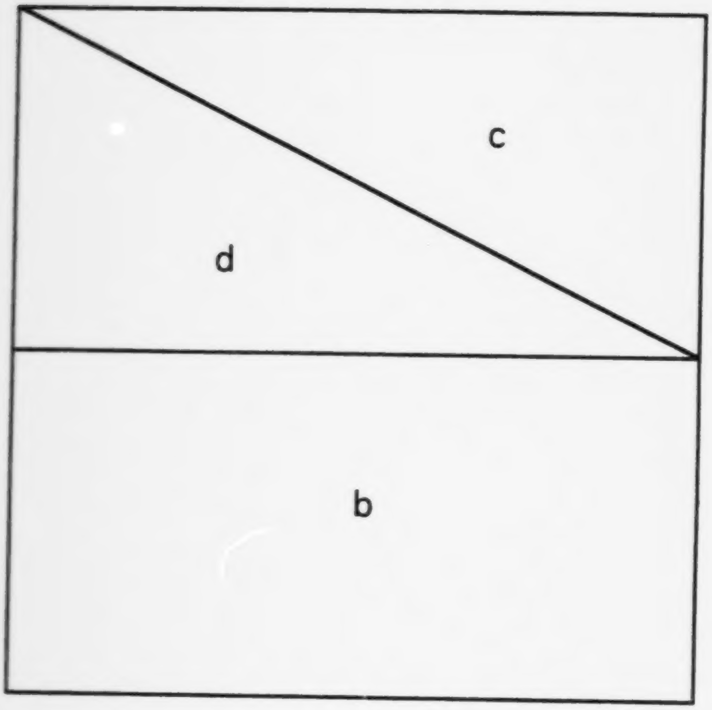
(**NOTE TO THE TEACHER**: Some pieces may be combined to form an "incorrect " square, thus, keeping the rest of the group from completing the activity. One component of learning to cooperate is recognizing when something that one person has done hinders the progress of the group.)

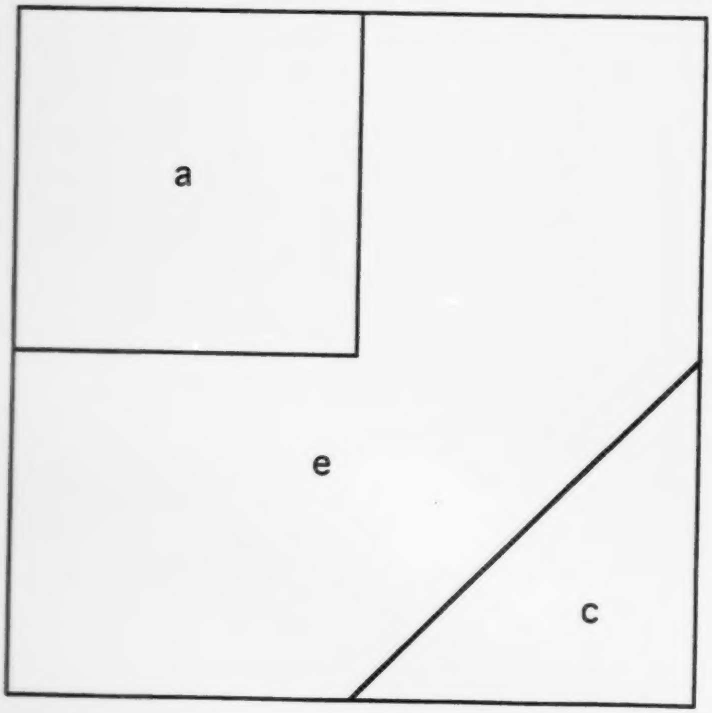
Evaluation:

When all the groups have completed their squares. Discuss this activity with the whole class. Focus on the following questions:

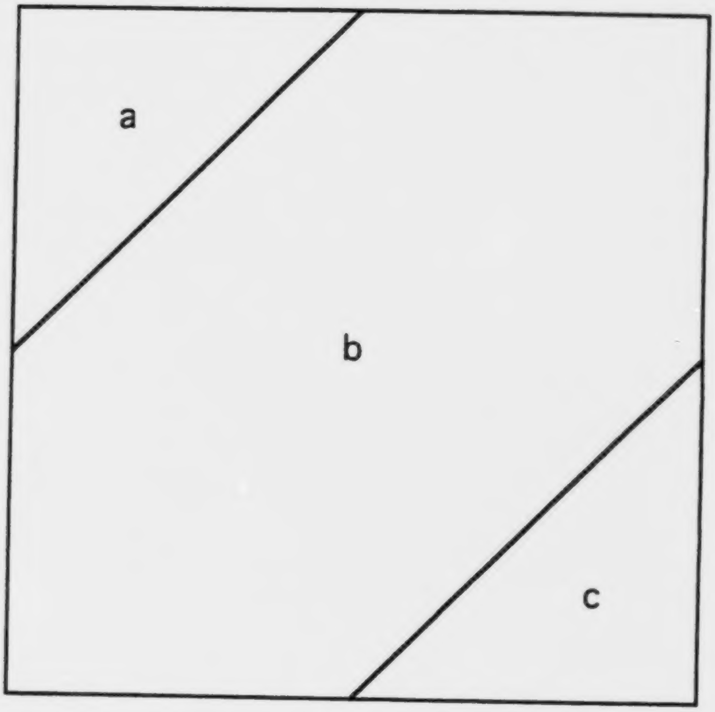
- How did you feel about playing this game?
- Did you feel or observe a sense of cooperation among members of the group?
- How did you feel about not being able to talk?
- How is working in a group different from working alone?
- How can this activity help us understand the problems the Earth Summit participants faced in trying to cooperate?

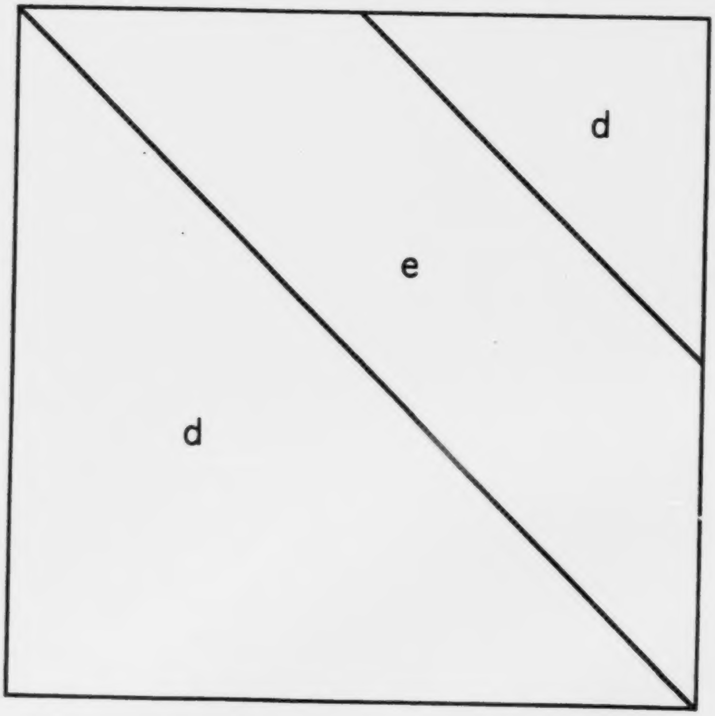
COOPERATION SQUARES



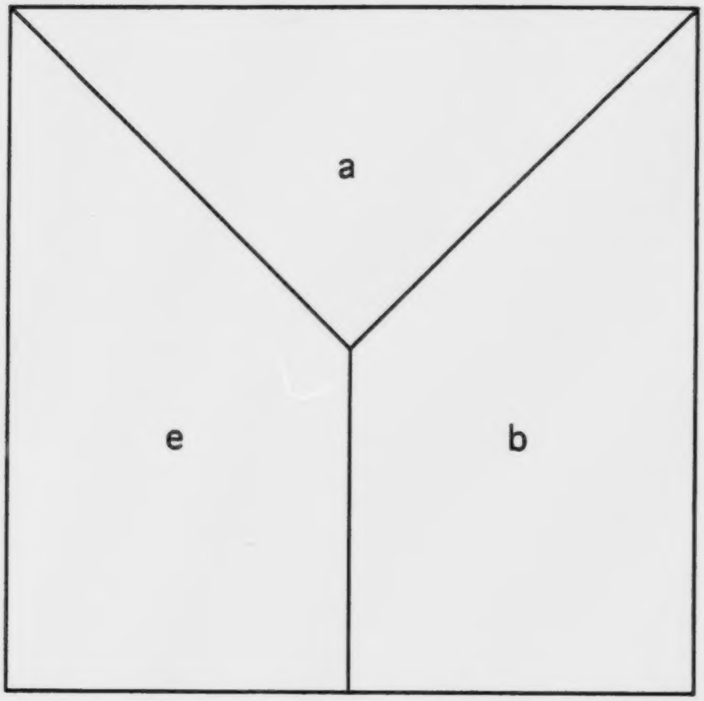


COOPERATION SQUARES





COOPERATION SQUARES



POWER AND WEALTH # 1

This activity illustrates the need for cooperation in the allocation of natural resources. Prior to conducting this activity, copy the grid pattern which is provided. One grid is required for every two students.

Procedure:

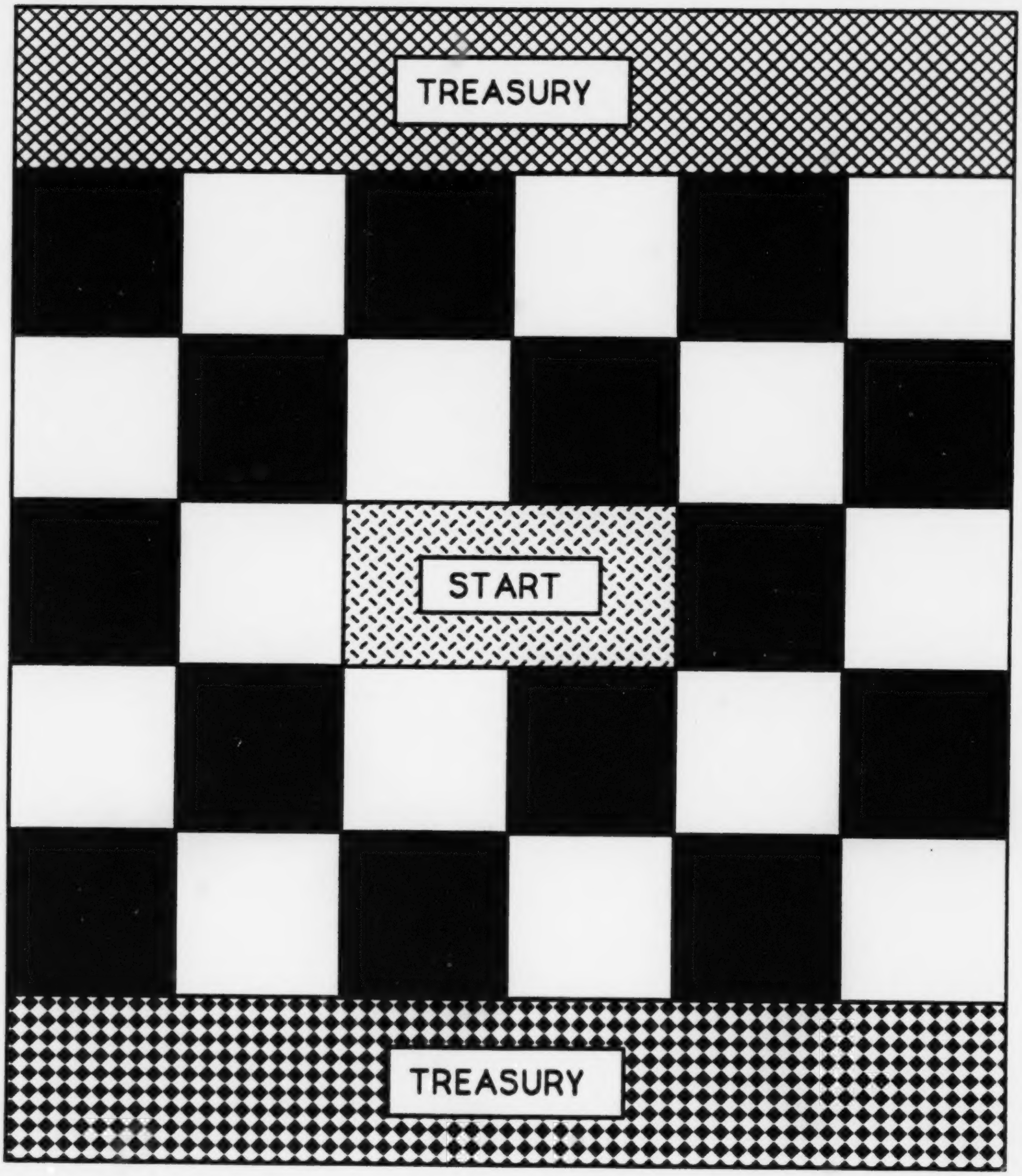
1. Divide the students into groups of two.
2. Give each group a game grid and one coin. Actual money is preferable. You may give each group the same kind of coin or vary the coins used.
3. Place the coin on the middle square and give the following instructions: "First, flip your coin to determine who will move first. One player will flip the coin, and the other player will call "heads" or "tails". The player who wins the flip will move first. Once you have determined who will move first, place the coin in the "start" box. The player who won the flip can move the coin one space, to any adjacent box. It is now the other player's turn. The second player may now move the coin, one space, to any adjacent box. The players take turns, moving the coin one space per turn, to any adjacent box. The first person to get the coin into his/her treasury wins the game. You will play this game four times. The person who wins the most number of games, wins the set.

(**NOTE TO THE TEACHER**: No one can win this game without the direct cooperation of the other person. It will be interesting to observe which pairs of students do produce winners, and which pairs do not.)

Evaluation:

- Have all pairs of students share their reactions to this activity with the rest of the class.

POWER AND WEALTH


TREASURY
START
TREASURY

BEST COPY AVAILABLE

POWER AND WEALTH # 2

This activity illustrates the relationship between power and the allocation of resources. Make one copy of the grid pattern for each group of two students before starting this activity.

Procedure:

- Give the following instructions:

  "Flip your coin to determine who moves first. One player will flip the coin and the other player will call "heads" or "tails". The player who wins the coin flip represents a "developed" nation from the Northern Hemisphere, will move first, and can move two squares per turn. The other player represents a "developing" nation from the Southern Hemisphere and can again, move only one square per turn. To begin the game, the coin is placed in the "start" box. The first person to get the coin into his/her treasury wins the game. Again, we will play this game four times."

Evaluation:

When the teacher chooses to end this activity (there may be some pairs of students that will never produce a winner!), discuss this activity with the whole class. Focus on the following questions:

- How did you feel about playing this game?
- How can anyone win either of these games?
- Can a "developing" country ever win in this game? How?
- How can this activity help us understand the problems that the
- Earth Summit participants faced in making the decisions regarding how the planet's natural resources should be shared?

UNITED WE STAND

This activity demonstrates the need for mutual cooperation in solving a problem, and how one non-cooperative individual can prevent the success of the whole group. No materials are required for this activity.

Procedure:

Choose two students to demonstrate this activity. Have these two students sit on the floor or ground, back to back, and link their arms at the elbow. Tell the students to stand up, keeping their arms linked. (In order for the students to stand up, they will need to lean on each other.) After these two students successfully demonstrate this activity, allow other pairs of students to try it. Now, try this same activity with groups of three students, groups of four students, etc.

Evaluation:

- Discuss this activity with the whole class. Ask the students what would happen if one person in the group refused to try and stand up.

SUGGESTED ADDITIONAL READINGS

Abruscato, J. & Hassard, J. (1976) Loving and beyond: Science teaching for the humanistic classroom, pp. 26-27. Pacific Palisades, California, Goodyear Publishing.
Adler, J. & Hager, M. (1992, June 1). Earth at the summit. Newsweek, 119 (22), 24-33
Aksyonov, V. (1992, June 9). Polluted by a land utopian idealogy. Arizona Republic, p. B9.
Begley, S. (1992, June 1). Is it apocalypse now? Newsweek, 119 (22), 36-42.
Easterbrook, G. (1992, June 1). A house of cards. Newsweek, 119 (22), 24-33.
Elmer-Dewitt, P. (1992, June 1). Rio: Coming together to save the earth. Time, 139 (22), 40-65.
French, H.F. (1992, May-June). From discord to accord. World Watch, 5 (3), 26-32.
Levine, M. D. & Meyers, S. (1992, Spring). The contribution of energy efficiency to sustainable development in developing countries.
Natural Resources Forum, A United Nations Special Issue, 19-26.
O'Riordan, T. (1992, April). Editorial. Environment, 34(3), p.5.
O'Sullivan, E. (1992, May 29). Environment debate gathers momentum. Middle East Economic Digest, 36,(21), 4-5.
Ottinger, R.L. (1992, Spring) Energy and environmental challenges for developed and developing countries. Natural Resources Forum, A United Nations Special Issue, 11-17.
Pastizzi-Ferencic, D. (1992, Spring). Natural resources and environmentally sound sustainable development. Natural Resources Forum. A United Nations Special Issue. 3-10.
Samuelson, R.J. (1992, June 1). The end is not at hand. Newsweek, 119 (22), 43.
Sigma Xi, & ICSU Secretariat. (1992, April). International. Environment, 34 (3), 2.
Silverstein, K. (1992, June 15). Earth summit ends with high hopes. Arizona Republic, pp. 1.
Third World-U.S. clash over saving the forest. (1992, June 11). Arizona Republic, p. B9.

EGG-STASY: AN EXPLORATORY PROBLEM-SOLVING ACTIVITY

(Grades 3-7)

By Teresa Olson

Every so often, in my opinion, a teacher should assign a project that makes their students, other faculty, and students' parents wonder about the teacher's mental condition. By that I mean that you should assign something unusual, with some of your objectives shrouded in mystery. This is a short description of such an experience.

Last February, my students were getting a little tired of standard school lessons. To energize 34 brains, I announced at the end of the day that we were having an additional science assignment, a project due in one week's time. After a chorus of whining at a high decibel level shook the rafters, I held out the carrot. There will be no writing involved, and there will be prizes, with the winners chosen by a class vote.

Now that I had their attention, I explained in a rather vague tone, which they found particularly annoying, and therefore grilled me to search for details and unforeseen circumstances:

"You will design a vehicle in which we will place a raw egg. I'll then climb up on the roof and throw them all down. If it doesn't break, you get an "A". If it breaks, you get a "B". If you don't make one, you fail the assignment."

Then there was a barrage of questions which functioned to outline our specifics:

Student: "How big can it be?"
Teacher: "You will have to be able to carry it to school, and I'll have to be able to carry it up a ladder."
Student: "What should I make it out of?"
Teacher: "What will your folks give you permission to use?"
Student: "Miss Olson, have you gone nuts?"
Teacher: "Possibly, but that has nothing to do with the assignment"
Student: "Can we make two?"
Teacher: "Certainly."
Student: "Could it have a parachute?"
Teacher: "I don't see why not."
Student: "Can we completely coat the egg with rubber cement?"
Teacher: "It has to end up in a usable form - for cooking, I mean."
Student: "Exactly what will they be judged on for the prizes?"
Teacher: "Well, I don't know - what do you think?"

We eventually settled on using the standards of effectiveness, efficiency, and overall design. The students felt that some artistic flair in packaging should get a higher point rating. We also decided as a class that any student who didn't finish the assignment should not be allowed to go along for the 'roof toss,' as they probably wouldn't have enough reason to behave, and might cause problems for the others.

The building maintenance worker was duly consulted, and left in doubt of my sanity. A ladder and immediate garbage pickup was arranged. Friday dawned. As I listened to my students' chatter in the A.M. line-up, I realized most of them had spent more time working on this assignment than they had on all of the rest of their homework combined. Security for some of the projects to prevent design pirating had been extensive. When the time came to climb the ladder, only 7 of 33 students were unprepared.

I threw the egg-mobiles off the roof, and we came inside to check results. As the students walked back into the room, I became aware of an air of dejection, and I assumed that many of them had not been successful. After a show of hands revealed that nearly half had been successful, I asked them what was wrong.

Apparently, a one floor drop was not a significant challenge. I asked them if they wanted to try to figure out a way to drop them from a greater height, and hold the judging until that time. There was an overwhelming vote of 'yes,' and when I said I had no idea where we could go, they solved that one for me by suggesting a site only 2-3 blocks away which had a history of sponsoring school activities, and best of all, had four floors.

I then asked if there were any kind hearted souls who had been successful today who could share tips on building a better egg-mobile. The concepts of insulation, preventing movement of fragile objects in commercial packing, and slowing the descent were discussed at this time.

Time passed, all the appropriate people were contacted, field trip permission forms were collected, and all but two students had completed the assignment. Many of them had gone through an extensive research and development process. The most significant new data discovered was that smaller eggs have tougher shells. The school's principal and student advisor accompanied us to the venue of this 'egg-citing' event. Since the drop site was a landing off a public access flight of stairs, the students were allowed to drop their own projects.

FINAL RESULTS

Sixty-six percent of the egg-mobiles provided adequate protection to the eggs inside them. Devices designed and developed by the students included parachutes, a suspension system of rubber bands and toothpicks, and a dazzling assortment of insulation choices including popcorn, pillows, and underwear.

The students opened and checked the egg-mobiles at the drop site, which eliminated a golden opportunity to study the amount and type of garbage that was produced. Next year, I will take the students back to the classroom before I let them open their egg-mobiles.

The design which won first prize was shaped like an armored tank. It was also moderate in size and used a recyclable paper product as packaging material to protect the egg from the impact of the fall.

ENERGY EXPLORATIONS

(Grades 6-8)

By Teresa Olson

INTRODUCTION

Even though there are a variety of excellent energy education programs available to classroom teachers, many teachers, myself included, shy away from instruction dealing with themes involving energy. Since we perceive weaknesses in our personal knowledge base in this area, and since we do not wish to take the risk having our lack of knowledge exposed, we shy away from using energy education activities in the classroom. We also visualize these themes as being too expensive to explore in an elementary or middle school setting.

During the summer of 1992, I had the opportunity to explore the area of energy education and develop a series of classroom lessons and activities. These lessons and activities are designed to develop, among students, a knowledge of current rates of energy consumption in the U.S. and a concern for the current energy resource situation in this country. These lessons will also suggest solutions to some of our energy problems.

EXPLORATION OF ENERGY ISSUES

Start with the question, "Who can tell me something they know about our current energy resource situation in our town, state, or country? I'd like to write up all the ideas, knowledge, and concerns you have as a starting point for our study of energy."

This is a brainstorming activity, so consider all of the student comments that are on the topic, without editorializing. Restrict the activity to about 10-15 minutes maximum, or it will become a discussion. After you have elicited a good cross-section of statements and concerns listed, ask if there is a way to narrow these things down, to make them more manageable, for further study. The class should focus on major themes of study. They will identify major areas not mentioned here, but some major areas which might be explored are:

- The nature of energy
- Different forms of energy
- Methods by which energy is supplied to your geographic area
- Kinds of energy used in your area
- Amounts of each kind of energy used in your area
- Costs of the energy used in terms of both economics and the environment.
- Identification of energy problem areas
- Identification of probable action plans for remediation of problems

Have your class devise a method for researching and reporting on these topics, issues and problems. Provide opportunities for library research and class reporting. Pick an area of research responsibility for yourself, and require that all of the students do the same. Individual student projects and cooperative learning groups would both be valuable experiences for knowledge development at this phase.

At this point of development in a unit, it is important to help the students develop some method of data collection and storage. You should identify some method of record keeping to be used throughout the unit. Some suggestions are portfolios, journals, bulletin boards, reference sections in the classroom and school library, and a data base to be stored in a classroom or school computer system.

One of the major goals of STS instruction is to enable students to "Think, and Act," so that they can "Make an Impact!" When exploring some of the real world problems students face, remember that there is a possibility that students may react with fear, depression, and/or apathy. Help your students to express some of their concerns through actions that will positively effect their environment. Help them learn to practice conservation, and to encourage others in their lives to practice it too. Please refer to the article titled "Thirty Day Energy Conservation Calendar," in this handbook for some home conservation activities. You may also have your students develop a public service video to share with other classes or schools.

ENERGY EXPLORATION INSTRUCTION

I have searched many educational and physical journals and textbooks to try to find a simple explanation and definition of energy, and the only thing I found was a realization that there wasn't one! A standard definition of energy that is frequently given is "The ability to do work". The problem with this definition, is that the complete and correct scientific explanations of "work" and "energy" are too complex for all but the collegiate level of instruction. I recommend that you do not attempt to give the term "energy" a quick definition. Focus instead on demonstrating the nature of energy through hands-on activities suitable to the learning abilities of your students. These activities will enable your students to understand some simple concepts and terminology associated with the topic of energy. This terminology has to do with the applications and characteristics of energy that are relevant to our daily lives. These activities are intended to involve little cost or preparation.

THE LAW OF CONSERVATION OF ENERGY

Energy is conserved, and never lost in a reaction. It merely changes form. This is the Law of Conservation of Energy. To demonstrate this law, first ask the students to write it down in their notes, and think about what it may mean. Brainstorm a list of different types of energy. Explain that for the purposes of instruction and simplicity, you will use a short list, that while not absolutely complete, will be sufficient for classroom use. Show how these different forms of energy can encompass all of their suggestions.

FORMS OF ENERGY

1. Chemical energy
2. Electrical energy
3. Heat energy
4. Light (radiant) energy
5. Mechanical enery

CONVERSION OF ENERGY FROM ONE FORM TO ANOTHER

To demonstrate the law of conservation of energy, light a candle, and then blow it out. Ask the students if the energy they just saw demonstrated has been lost. They will most likely say yes. Relight the candle, and ask for a student volunteer to come forward. Ask the student to cup their hands around the flame and ask what they feel. They will answer, "Heat". Now ask the class what they all see when the candle is burning. They will answer, "Light". Write this statement out on the chalkboard, "The burning candle is an example of chemical energy . The chemical energy changes its form to heat and light energy." Explain that these energy forms naturally flow away from the candle to areas where there is less heat and light. Even though the energy appears to be disappearing, it is only changing form, and moving out to another area which doesn't have as much of that type of energy.

If they still seem confused, give other examples of energy transformation and flow. Ask them to imagine that it is dark outside, and they are walking underneath a window of a room in which a single candle burns. They are too far beneath the window to actually see the candle. Would they see light? Why? (Because the light energy is traveling through the window to an area that has less light energy.) Ask them to imagine the same sequence on a sunny day. Would they see the light? Why not? (Because there would be more light energy on the outside of the building.)

A good homework assignment would be to require the students to think of all of the examples of energy changing form that they can think of. Some examples of this are:

- Chemical energy (food) changing to mechanical energy (walking)
- Solar energy (sunshine) changing to chemical energy (plant growth)
- Electricial energy changing to heat (hair dryer)

When students return their homework, have them read aloud their different examples of energy changing from one form to another. After a few examples, arguments will arise about an example when students can't agree about the exact form of energy they are discussing. For example, someone might want to call a light bulb a source of heat energy. Just explain that many energy reactions involve more that one form of energy at once. There will also be questions that you won't be able to answer in this lesson, and throughout the lesson. Don't be threatened by this! You don't need to know everything to teach an interesting unit on energy. Simply admit that you don't know, and ask the students to find out for you. Offer extra credit and an opportunity to share their findings with the class. Reinforce the class goal of learning and discovery, and commend students for bringing up difficult questions. Now that your students understand that energy changes form, they are ready to learn about, Potential and Kinetic Energy.

POTENTIAL ENERGY	is frequently defined as the energy that an object has due to its position. Other sources refer to is as stored energy, or energy waiting to perform work. It should be noted that chemical energy is also considered to be a form of potential energy that is released during a chemical reaction.
KINETIC ENERGY	is defined most often as the energy of motion. Kinetic energy is generally associated with movement, or mechanical energy.

A WALNUT CRACKING MACHINE

Materials:

a. Two large books of approximately the same size and shape
b. Two pieces of paper
c. A walnut (with shell)
d. A large piece of butcher's paper
e. Masking tape or rubber bands large enough to stretch around the two books

Procedure:

1. Simply place the walnut between the two sheets of paper, and then place them between the two large books.Wrap the entire package in the butchers paper and close with masking tape or rubber bands.
2. Place it on a ledge high enough to crack the walnuts, if it should fall.
3. Explain the concepts of Potential, Kinetic, and Chemical energy. Ask your students to write a definition of them in their notes. Ask your students to identify the potential energy available in the position of the walnut cracking machine located on the ledge. (If it falls, the potential energy caused by the pull of gravity could do the work of cracking the walnuts for you.)
4. Ask for a student volunteer to come forward. Introduce the student as your 'human machine'. Pop some sort of food item like a cracker, chunk of fruit, or the ever-popular candy in their mouth. Explain that the human machine will use the potential energy of the food, digesting it, using chemical energy to release the potential energy of the food. The human machine will push the book off of the ledge, releasing the potential energy of its position, and allowing it to perform the work of cracking the walnut.
5. Have the students draw a mock-up of the activity in their notes, and label the involved concepts.

THE NATURE OF ENERGY-HEAT FLOW

Heat is defined as the total internal energy of the molecules of a substance. (You may wish to refer to the article "Weather and the Water Cycle" printed elsewhere in this volume, for the activity, "The Dance of the Moving Molecules".) Heat is gained in one of two ways:

1. Through conversion from other forms of energy, as discussed in the previous section.
2. Heat flow

Heat flow is quite simple to demonstrate. There are a variety of low cost methods which are suitable for demonstrating heat flow. Here are a few:

1. Drop a small piece of crushed ice in each student's hand. Ask students to hold it in their palm and think of ways to describe what is happening. The first, and most obvious answer that will come up, of course, will be, "It's melting." After that is out of the way, ask them to only suggest ways to describe what is happening that no one else has used before. You will hear all of the standard replies such as "It's turning to water." Eventually, one of the students will mention temperature, probably with a statement about his or her hand growing colder. One of the students may even stumble upon what you are looking for and say, "Heat is moving from my skin to the ice, because there is more heat in my body than in the ice."
2. Hot soup anyone? Provide soup that's a bit too hot for enjoyment to one or more of your students, and ask them what strategy would they use for eating the soup without burning their mouth. From standard elicited answers, lead students into the concept of heat flow. Teacher comment might be, "We blow air on only one spoonful at a time, so that the heat from the soup will flow into the cooler surrounding air.
3. **INSULATION CONTEST:**

   Materials needed:

   a. 2 baby food jars per student or group
      1 empty jar for design practice
      1 jar filled with 100 ml of frozen colored water
   b. Graduated cylinder (100 ml size)
   c. Wall chart for reporting results
   d. Student reporting and evaluation form

   Procedure:

   Explain that insulation is a device we use in many places to slow heat flow. Ask students to list places where insulation is used. They will list uses such as homes, thermos® bottles, coolers, and refrigerators. Explain that there are several factors determining the value of a particular type of insulation, and that you want them to discover for themselves what some of these factors are, so you have a 'special' homework assignment for them to work on. Provide each student, or student team, with an empty baby food jar. Explain that on an assigned date, they are to bring in a self-designed insulating device to fit around the baby food jar. You will then give them an identical baby food jar in which 100 ml. of colored water has been frozen.

The object will be to slow heat flow from the surrounding warm air. This will be measured by the amount of ice that melts. They will place the jar with the frozen ice inside their device, and wait for test results. (You may wish to increase to 200 ml, but the 100 ml amount was recommended because final results could easily be reported in terms of percentages.)

On the day that the devices are due, have the students load the ice-filled jars into their devices and place them in a warm area for a period of time that will allow some significant melting of the ice. This will differ depending on the resources available at your school. If it is a warm, sunny day, you will be able to place them in the sun for a few hours. The students should be made aware of whatever warming was chosen at the time the original assignment was given.

After the devices have been warmed in the sun, bring them in, and measure the total amount of water that has melted from the ice. Ask a student to record class results on a collective wall chart or graph. Pass out a project reporting form. Have the students report the amount of water collected and describe the insulating device. Ask the students probing questions about the types of materials used to design their devices. Explore questions of cost, size, ecological concerns of chosen materials such as the garbage created, and the cost of the insulation materials used. Your students may wish to conduct the experiment again, using more stringent standards. They may wish to eliminate Styrofoam®, limit the volume, or require that the insulation be recyclable.

THE NATURE OF ENERGY - LIGHT ENERGY

The true scientific theory of the properties of light is too complicated for the learning abilities of most of the students of this age group. We need to use some form of representation to explain the properties of light, however, and so we will fall back on the light ray model. There has been much discussion on the meaning of this model, but for simplicity's sake, let's just say that there is a luminous "something" that travels in a straight line.

LIGHT AND MATTER

Light will react differently with different materials. This depends largely on the qualities of the materials. If the materials are very smooth, the rays of light may bounce of them, and we call this reflection. Some materials are transparent, and will let light particles pass through them. Some materials are opaque, and will not allow light to pass through them. Then the light is either reflected, or partially or completely absorbed. If the material absorbs light, it will most often be observable in a changed form as increased heat.

ACTIVITY

Materials:

1. Several clean empty vegetable cans of equal size
2. Paint or construction paper in several colors (black, white, and an intermediate color such as blue are the minimum, but you may wish to add other colors.)
3. Thermometers (One for each color)
4. Water
5. A sunny location to run the experiment

Procedure:

Paint or cover the cans with colored paper. Fill them with equal amounts of cool water. Take initial readings of their temperatures to insure that each can has water of equal temperature. This would be a good time to make sure your students know how to read a thermometer. There may be a few that might not know how to read them.

Place the cans in a sunny location. Check back in a couple of hours, and record the temperature of the water in the different cans. Have the students record the results and their observations in their notes.

THE NATURE OF ENERGY - WHAT'S A WATT ANYWAY?

MEASURING ENERGY

Students, and most adults, are confused about the concept of measuring energy. This article will deal with limited aspects of this difficult concept. While it is not necessary to be a brilliant physicist to teach elementary school science, it is, however, necessary to have a general understanding of the nature of energy. We will stick to simpler aspects of energy use and measurement.

To try to measure energy, scientists make use of the following definitions of work power, horsepower, and watt:

Work = Force x distance
Power = The amount of work per unit of time
Horsepower = Power rating of 550 ft. lb. per minute
Watt = Metric Power rating (746 W = 1 horsepower)

Note: Watts for large amounts of energy
1 kilowatt (kW) = 1000 W
1 megawatt (MW) = 1,000,000 W

Btu = Amount of heat needed to raise the temp. of 1 lb. water by 1 F
Quad = One quadrillion Btu (10 to the fifteenth power)
(Quads are used to report huge uses of power, such as a nation's yearly use of energy.)

To teach these concepts, ask your students to copy the definitions in their notes, and think about what they may mean. You may find excellent methods of demonstrating these concepts in many teachers' manuals. I have included a time honored method of teaching work, power, and horsepower.

Materials:

(a) Advertising brochures of sport cars that include vehicle horsepower
(b) A bathroom scale
(c) A flight of stairs (Measure its full height, from the bottom of the first step)
(d) A class set of "Watt's my Horsepower Recording Chart" (A copy master is included.)
(e) Overhead transparency of the reporting chart
(f) A stopwatch

Procedure:

Start the discussion by showing the car advertising promotionals, and read their engine's horsepower rating. Then ask if anyone knows what the horsepower rating means. Someone will answer with the word power. Ask for student volunteers who are curious to know what their horsepower rating would be. Weigh these students and enter their names and weight ratings on the reporting chart. Escort the students to the location of the stairs, and time each of the students as they run from the bottom to the top. Record each of their individual times. Now escort the students back to the classroom to complete the math instruction session.

An interesting extension activity would be to ask the students how they would increase their horsepower rating. (They would have to increase the load by carrying weight, or decrease their time.)

RENEWABLE AND NONRENEWABLE ENERGY

As a homework assignment , ask the students to list all of the different uses of energy they have seen used. Explain that they will be using their lists during the following day's lesson.

Kick off the next lesson with a session focusing on brainstorming energy uses from the students' prepared lists. Try not to repeat the same uses. After a good representation has been made of the various uses they have seen, you may wish to discuss the 'hidden' energy costs which they might not have thought of, such as the energy that had to be used somewhere to make their clothes, the bread they ate at last night's meal, or any new purchases that may have come into their lives. Ask the students where the power comes from for these energy uses.

Inform your students that you believe they have learned enough about energy to begin preparing for their lab test, and pass out the "Classroom Assignment Lab Test."

WATT'S MY HORSEPOWER RECORDING CHART

NAME:______________________________

CLASS:__________ DATE:__________

Work = Force (Student's Weight) X Distance (Height of Stairs)
Power = The amount of work divided by the time
Horsepower = Your power figure divided by 550

Name	Weight	Stair Height	Time	Work In ft lb	Power In ft lb/sec	Horse-Power

CLASSROOM ASSIGNMENT
LAB TEST

NAME: ____

CLASS: ______________ DATE: _______________

1. Now that I have raised your anxiety level sufficiently high by announcing a surprise test, relax, it's not due until ____________.
2. This will be a performance test. Your group will be seated at a table. You will have a variety of objects on your desk. You will devise a method of distilling clean water from ordinary everyday objects lying on the table in front of you. To help visualize a solution, perhaps you could imagine something like this:
   "You are with a group of people, and you are lost. There aren't any non-renewable sources of energy left, and the drinking water is dirty. You need to think of a way to produce clean drinking water using only renewable energy sources which are available."
3. You have a week to consider your probable course of design.
4. Plan, discuss, read, and research an answer. You have a week to consider your design and gather all needed supplies.
5. Notify me of your choice, either to be part of a group, or work alone.
6. Groups may have 2, 3, but no more than 4 students.
7. Read below for information on hints.
8. Good Luck!

Hint #1: This one's free. I didn't say you couldn't bring supplies into the classroom with you. Just remember, you can't use any source of non-renewable energy. If you have chosen solar energy, and the sun isn't shining, we will substitute lamps for the purposes of demonstration.

9. Grading:
   - A You think of a working solution, either by yourself, or within a group. You might even think of more than one.
   - B You used someone else's idea, but gave them credit for it.
   - C You didn't get anything figured out during the actual lab test, but you built something, and turned it in later.
   - D You cheated, but completed the assignment.
   - F You didn't complete the assignment.

I read, and understood, this page ______________________________

ADDITIONAL HINTS

(This page has no additional charge, but a tip would be appreciated.)

We generally think of these fuels as non-renewable:
Coal
Natural Gas
Oil
We generally think of these fuels as renewable:
Biomass
Geothermal
Solar
Water
Wind

There are some questions to be considered here. For example, if you make oil out of something renewable, would we have something we could call renewable? Think about it.

Recent evidence suggests that Geothermal sources may need to be reclassified as non-renewable. The source for geothermal energy is hot steam that comes from within the earth's crust. In recent years, the output has been dropping. That's not a good sign. Also, there are a lot of mucky, dirty, mineral-filled particles laden in that steam. That damages pipes. That's expensive. You have to replace a lot of items that are made of non-renewable or non-recyclable materials. That's stupid.

Recent studies suggest that wind power could replace all of the other sources of electricity in our country. At present levels of energy consumption, we would only have to access approximately one third, or less, of the wind energy available in the country. North Dakota could become the "Wind Capital" of the nation. This is not a surprise to those people who have lived there. How does your state rate as a wind energy capitol?

If our non-renewable sources of energy continue to be consumed at the rate in which they are currently being used, we will run out of them in 40 to 50 years.

The effort of building new power plants equipped to make use of renewable energy would provide thousands of jobs.

There are frequently unseen problems with any new technology implemented on a large scale. The benefits of renewable energy seem obvious. What long-term problems might be caused?

What do you think should be done?

TO THE TEACHER

On the day of the Lab Test you will provide materials to make a solar "Clean Catch Cup" distilling unit for all students not able to design one of their own.

Materials:

Each group will need

(a) Solar energy source or mock up of solar energy source.
(b) Plentiful supply of muddy water
(c) Small clean glass or cup (should be fairly heavy)
(d) Pan for muddy water (greater in base and height than clean cup)
(e) Cellophane wrap
(f) Pebbles

Procedure:

Pour 1 inch of muddy water in the bottom of the large pan. Place the smaller, "Clean Catch Cup" in the center of the muddy water. Use a large piece of cellophane wrap to loosely cover the top of the pan. Place the pebble in the center of the cellophane wrap so that the wrap will dip down towards the clean cup. Place in the sun, and wait for the processes of evaporation and condensation to do their work. Droplets of water will condense under the pebble, on the cellophane, and collect in the cup. As a product of distillation, it will be clean water.

It is to hoped that this unit will give you a solid beginning and perhaps a greater understanding of some of our energy resources and problems. Search for more complex information as you are ready for it. There are a variety of low-cost options available to the classroom teacher.

OTHER THINGS TO CONSIDER

There is an ecological issue to address in some of the uses of hydroelectric power. Releasing water according to the rhythm of the human animal's power needs has a sometimes devastating effect on the natural habitats of the wildlife of the area. Releasing water to make power at peak power demand times is a good deal less expensive than using the natural water flow of a body of water, as you don't have to build as many power plants.

One of the major problems of developing an effective system of accessing the solar resource appears to be in public attitudes of the general population of the United States. The initial cost outlay is greater in most cases, although the cost effectiveness of the system over time is often lower when the system is properly built, maintained, and placed. Another major problem with developing solar technology is the lack of a clear political and legal policy of developing, zoning, funding, and inspecting these renewable energy technologies. Tax shelters created in the 1980's designed to encourage the development of residential and industrial use of solar power have not survived the current political agenda.

SUGGESTED ADDITIONAL READINGS

Sears, Robert L. (1991). "The potential for alternative energy in the U.S." In *Proceedings of the 14th World Energy Engineering Congress*, Atlanta, Georgia, pp. 615-621.

Tillery, Bill W. (1991). *Physical Science*. Dubuque, Iowa: Wm. C. Brown.

EXPERT STUDENTS TEACH SCIENCE TO NOVICE PARENTS

(Grades 4-8)

By Gerald Dameon, Douglas A. Freeman & Lynn Piwowarczyk

INTRODUCTION

A science activity night offers the opportunity to establish a cohesion between child, parent, and educator. The parent is enlightened to the role their child plays on a daily basis. This includes, but is not limited to, cooperative learning, the scientific process, problem solving, and communication. The child discovers the need for communication skills as an instructor, the need for patience, and the need for organization. The self-esteem of the child is nourished through security of inquiry to ultimately realize success. The educator has the opportunity to build a successful learning environment for the child. He/she also can strengthen the rapport with parents and community members. Educators may also seize this opportunity to enhance the parent-child relationship.

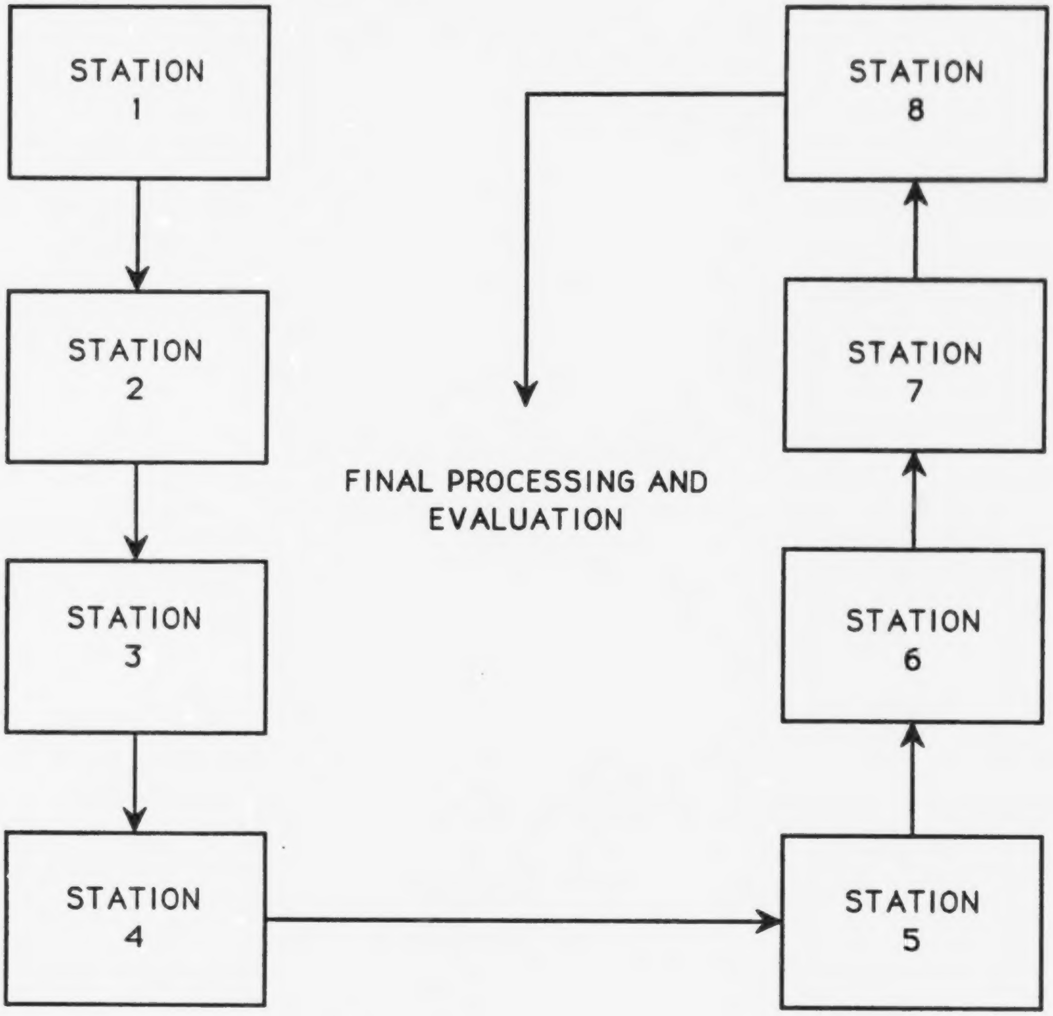
Student experts conduct the science activity night. Parents and family members participate in energy oriented experiments by experiencing the same learning process as their children. These processes include the establishment of cooperative learning between parent and child, the use of the scientific method, and the development of more effective communication skills. The format for such an event is presented below. You may, however, wish to alter it to meet your needs.

PHYSICAL PREPARATION

When selecting a location take into consideration the number of participants and the activities planned. In this example eight stations are used based on the theme of energy, but any other theme or topic may be implemented.

Each station is operated by a team of three students. Teams present their designated problem to the adults. Parents make predictions, solve problems, draw conclusions etc., much as their children do in the learning process. Each group of parents rotates through the stations at five minute intervals. Parents begin at the station operated by their child and rotate in sequential order. (See insert A)

INSERT A


STATION 1
STATION 2
STATION 3
STATION 4
STATION 5
STATION 6
STATION 7
STATION 8
FINAL PROCESSING AND EVALUATION

TEACHER PREPARATION

The activities selected are determined by:

1. Size of the event
2. Age of students
3. Availability of materials
4. Theme

As the organizer you need to gather all materials needed, create step by step directions for each activity, prepare activity reports, and evaluation forms, arrange room for activity stations.

For an activity night using energy as the theme, one might consider some of the activities listed on these pages.

HIGH POWER JUICE

Materials:

(a) 1 - 1/2" X 1" piece of zinc
(b) 1 - 1/2" X 1" piece of copper or carbon
(c) 2 - 8" pieces of insulated copper wire
(d) 1 - lemon
(e) 1 - potato
(f) 1 - apple
(g) 1 - bread
(h) 1 - green pepper
(i) 1 - ammeter.

Purpose:

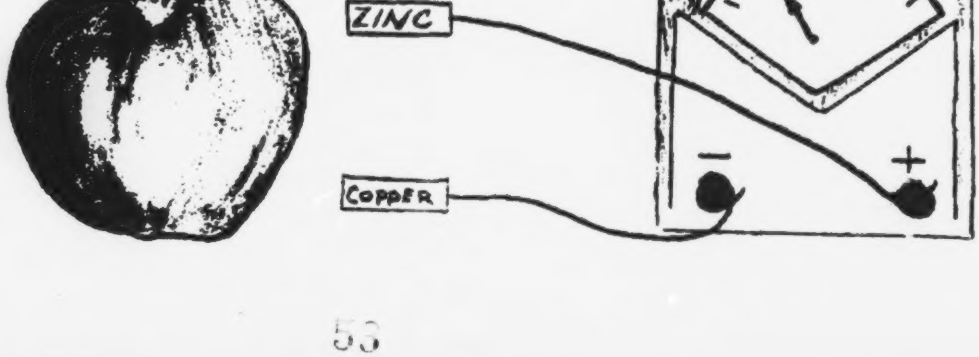
- To measure which material best conducts electricity.

Explanation:

- Zinc gives off electrons freely. Copper is quick to pickup these electrons. The lemon, potato, etc. will serve only as a field of conductivity. The ammeter, when connected, serves to measure the flow.

Procedure:

- Plunge zinc and copper into each food item, being careful they do not touch each other.



POWER UP

Materials:

(a) 3 - D batteries
(b) 1 - 6 volt battery
(c) 1 - iron bolt or spike
(d) 1 - 24" copper insulated wire
(e) 1 - roll electrician's tape
(f) 1 - scissors
(g) 1 - wire stripper
(h) paper clips

Purpose:

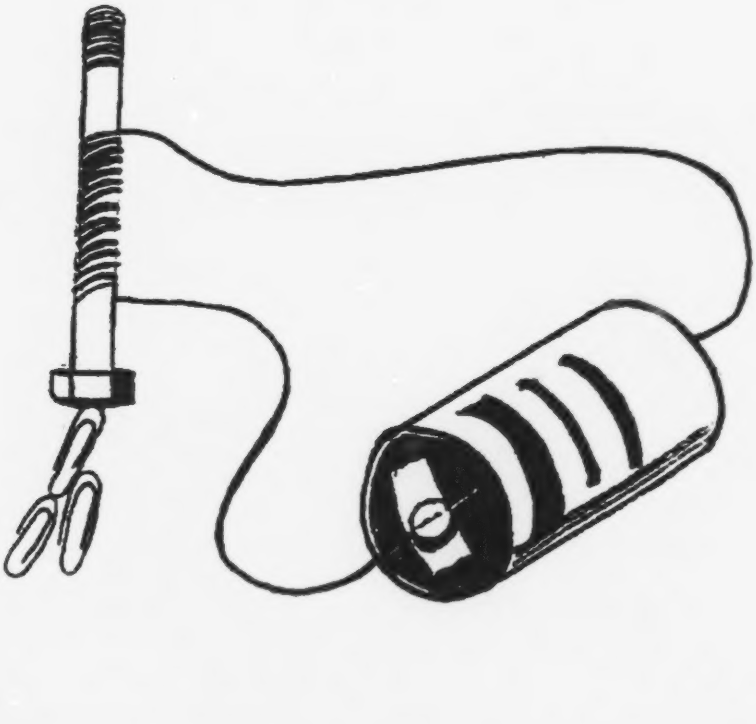
- To investigate ways of increasing the power of an electromagnet.

Explanation:

- An increase in the number of batteries connected to each other or an increase in the number of turns of wire around the bolt will increase the strength of the electromagnet. The strength of the electromagnet is measured by the number of paper clips it can attract.

Procedure:

- Using electrician's tape attach one end of the copper wire to the (+) terminal on battery. Initially, wrap the bolt with 10 turns of wire. Attach remaining end of the wire to the (-)terminal of battery.



LISTEN UP

Materials:

(a) 2 - matching sets of Legos®
(b) 1- divider
(c) 2- chairs
(d) 1- table

Purpose:

- Understanding verbal communication of directions to construct an identical model vehicle. The model will convert potential energy into kinetic energy.

Procedure:

- Participants sit on opposite sides of table with a divider between them. Students give directions on how to build an identical self propelled vehicle. The receivers (parents) may not ask questions or request clarification on given directions.

EASY LIFT

Materials:

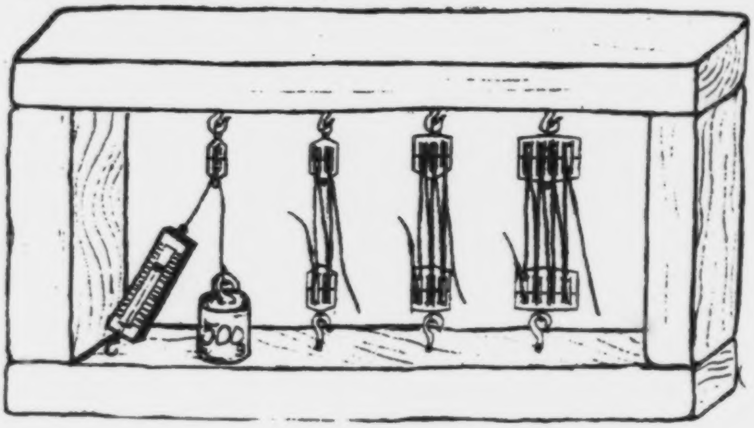
(a) 1 - one reel pulley
(b) 2 - two reel pulleys
(c) 2 - three reel pulleys
(d) 2 - four reel pulleys
(e) 1 - frame (see diagram)
(f) 4 - 500 gram weights
(f) 1 - 15' sash cord
(g) 4 - spring scales

Purpose:

- To estimate the effect various pulleys will have on a 500 gram weight.

Procedure:

- A 500 gram weight will be attached to one the end of each cord and a spring scale attached to the opposite end. Parents then estimate the reading for each scale with the pulleys being the variable.



WATER VAC

Materials:

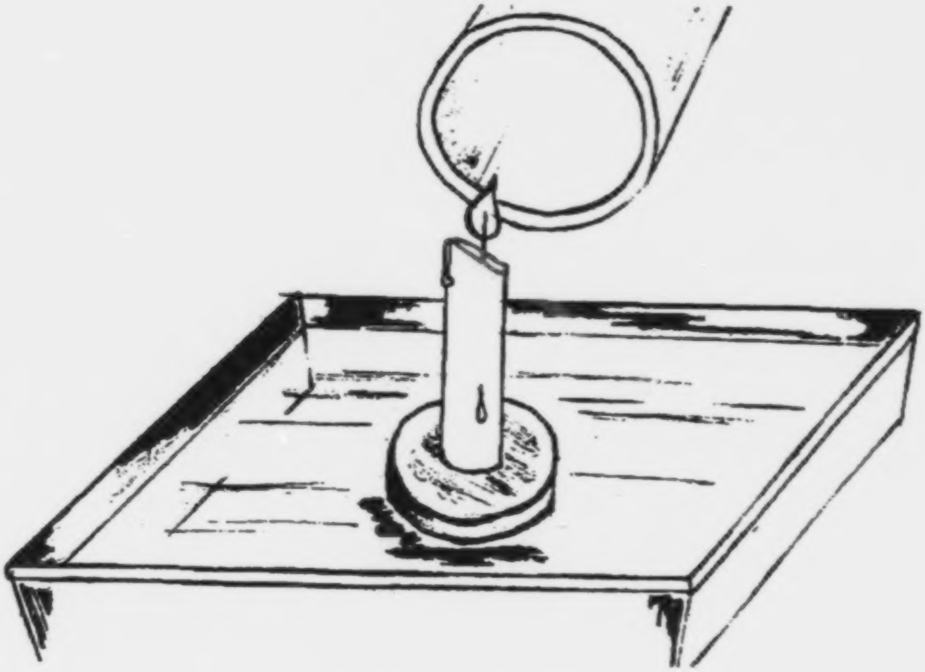
(a) 1 - small candle (eg. warming candle)
(b) 1 - small base, 1 1/2" diameter (eg. wood, cork disk)
(c) 1 - square cake pan
(d) 1 - clear drinking glass or glass jar

Purpose:

- To create a reduction of air pressure within a glass jar and observe the results.

Explanation:

- Candle burns up the oxygen in the glass creating a reduction in air pressure. When the oxygen is depleted, the water in the glass rises to fill the space and equalize the pressure.



BRAKING YO-YO

Materials:

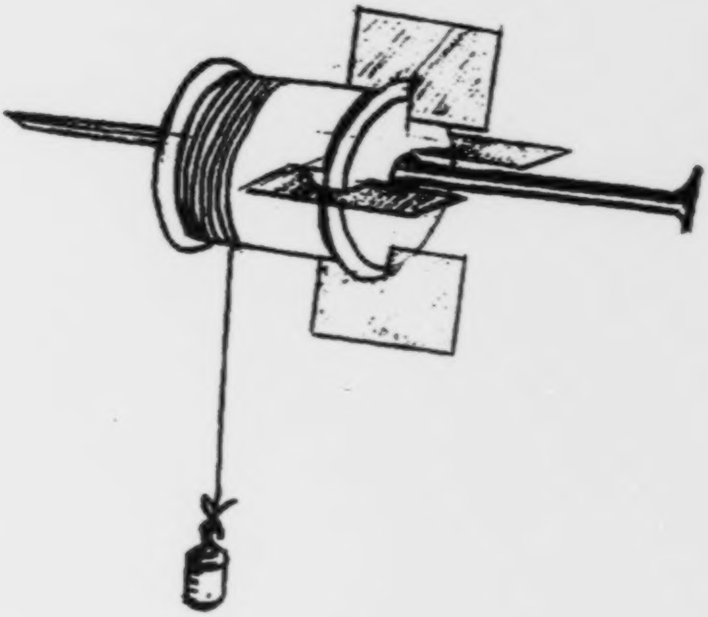
(a) 1 - thread spool (reel) with 4 slits at right angles
(b) 1 - five feet of thread
(c) 4 - 1" squares of tagboard
(d) 4 - 3" squares of tagboard
(e) 1 - 100 gram weight
(f) 1 - nail

Purpose:

- To demonstrate how speed is affected by air resistance.

Procedure:

- Take the reel with thread and place it on the nail. Wind 5 feet of thread around the reel. Place a 100 g weight on end of thread. Time how long it takes for the string to stop unwinding. Compare the times with and without tag board fins. Try different sized fins.



IT'S A GAS

Materials:

(a) 1 - test tube
(b) 2 - tablespoons of vinegar
(c) 2 - tablespoons of baking soda
(d) 1 - balloon

Purpose:

- To create energy by combining an acid and a base.

Purpose:

- Put the vinegar in the test tube. Put baking soda in the test tube. Quickly place the balloon over the end of the tube. Shake the tube and watch the balloon inflate. Combining an acid and a base releases carbon dioxide, thus inflating the balloon.

WHAT'S UP?

Materials:

(a) 1 - clear drinking glass
(b) 1 - large bottle of clear carbonated soda
(c) 1 - box of raisins

Purpose:

- To demonstrate buoyancy by the attachment of $C0_2$

Procedure:

- Drop 4-5 raisins into a glass containing a clear soda.

Explanation:

- Raisins having a greater specific gravity than the soda will sink to the bottom of the glass. Carbon dioxide bubbles attach themselves to the raisins causing them to rise to the surface. Upon reaching the surface the bubbles dissipate into the atmosphere permitting the raisins to sink again. This process will be repeated over and over again.

HIGH POWER JUICE
LAB SHEET

1. Record the amps measured for each of the following food items:

   (a) lemon: ______________________________

   (b) potato: ______________________________

   (c) apple: ______________________________

   (d) bread: ______________________________

   (e) pepper: ______________________________

2. Which food item conducted the greatest number of amps?

   ____

3. Which food item conducted the least number of amps?

   ____

4. Why do you think some foods conduct electricity better than others?

   ____

POWER UP
LAB SHEET

1. How many paper clips were you able to pick up with the original electromagnet?

   ____

2. Were you able to increase the power of the electromagnet?

   ____

3. How many more paper clips were you able to pick up after increasing the power of the electromagnet?

   ____

4. By what method did you increase the power of the electromagnet?

   ____
   ____
   ____
   ____

5. Explain why this method was successful or unsuccessful.

   ____
   ____
   ____
   ____
   ____

LISTEN UP
LAB SHEET

1. Was your vehicle identical to the senders?

____

2. How many differences were there in the two vehicles?

____

3. Where do you think the breakdown in communication occurred?

____

____

____

____

4. How could the communication be improved?

____

____

____

____

EASY LIFT
LAB SHEET

1. What was the recorded work load as measured by the spring scale for each of the pulleys?

   (a) One reel pulley: ______________

   (b) Two reel pulley: ______________

   (c) Three reel pulley: ______________

   (d) Four reel pulley: ______________

2. In your opinion, what caused the difference in the recorded weight of the object when using the various pulley systems?

   ____

   ____

   ____

   ____

WATER VAC
LAB SHEET

1. What do you think caused the candle to go out?

   ____

   ____

   ____

2. In your opinion, why did the water rise?

   ____

   ____

   ____

   ____

BRAKING YO-YO
LAB SHEET

1. Why did the spools move slower with the fins attached?

2. What could you do to speed up the spools?

IT'S A GAS
LAB SHEET

1. What inflated the balloon?

2. Where did the gas come from?

3. In your opinion, if you increase the amoung of vinegar and/or baking soda, will the balloon get bigger? Explain why?

WHAT'S UP?
LAB SHEET

1. Why do the raisins sink to the bottom when dropped in the soda?

2. Why do the raisins float to the top of the soda after first sinking to the bottom?

3. Would the same thing happen if the soda is left uncovered for three hours? Why?

SCIENCE ACTIVITY NIGHT EVALUATION

1. What did you learn fron tonight's activities?

____

____

____

____

2. Which activity did you enjoy the mosty?

____

____

3. Which activity did you enjoy the least?

____

____

4. How did tonight's experience bring you closer to understanding the learning activities your child participates in daily?

____

____

____

CONCLUSION

Through processing and final evaluation parents, students and teachers interact and discuss the activities as well as their outcomes. They are encouraged to express their comments on the usefulness of the scientific method. Students' self-esteem is bolstered through becoming on site experts, effectively communicating information to adults, and facilitating various activities.

FOOD FOR THOUGHT

(Grades 6-12)

By Linda Begalman and Sandra Israel

TO THE TEACHER

This unit helps to focus student attention on the many issues surrounding hunger. It is estimated that by the year 2000, over six hundred million people around the world will suffer from hunger, starvation, and malnutrition. Each year fifteen to twenty million people die from some type of hunger related disease. Children make up seventy-five per cent of this number. Every minute, twenty-four people on this earth starve, and eighteen of the twenty four are children under the age of five years. Some of the reasons behind this are political in nature. National and international relations sometimes break down over ecological issues. The purpose of this lesson is not to present moral, political, or economic issues. However, it is our intent to help students become aware of their role in the ecological system, and how their individual choices and actions can have an impact on the entire ecological system.

This unit is composed of three lessons. The topics for these lessons are:

1. Inequities in the distribution of food
2. Using an inter-relationship matrix
3. The need for cooperation to solve the problem of world hunger

ACTIVITY ONE - INEQUITY OF FOOD DISTRIBUTION

Materials Needed:

(a) Cookies
(b) Observation Sheets

Teacher Information:

This activity is suggested as an introduction to the concept of inequality in the distribution of food. Also included is the concept that women and children are the ones who suffer most from this inequitable distribution.

1. Prior to the start of this activity, select 2 or 3 female students to serve as your cohorts. Their responsibility is to observe the reactions of other students and take notes on their comments and behaviors. Inform these students of the purpose of this lesson.
2. Begin the activity by assigning various tasks to the other girls in the class,(erasing the board, straightening shelves, etc.).
3. As the girls are performing their tasks, pass out 2 or 3 cookies to each boy in the class, using all the cookies that the students can see. (Make sure that you have additional cookies hidden away!)
4. As you are passing out the cookies, the student cohorts should be observing and documenting the reactions and comments of the other students.
5. If any of the girls ask for a cookie, tell them "I don't have any more." If any of the girls ask why they weren't given a cookie, respond, "There's not enough for everybody." Allow approximately 10 minutes for this portion of the activity (for your own protection!).
6. Have all the students return to their seats. Explain that the purpose of this activity is to demonstrate the problem of inequity in food distribution as a major factor in world hunger. Ask the student cohorts to report on their observations. Discuss with the class the meaning of the words "inequity" and "distribution" and the intent of the lesson. Emphasize the fact that it is mostly women and children who are the victims of the inequity in the distribution of food. Ask the girls to share their feelings about not having a cookie, while the boys had more than one. Ask the boys to share their feelings.
7. In conclusion, pass out cookies to the rest of the class.

ACTIVITY TWO - THE INTER-RELATIONSHIP MATRIX

Introduction:

An event never occurs in isolation. Events interact and have an impact upon one another. There are many events that have an influence on world hunger. This activity will demonstrate the inter-relationship between hunger and various factors/events. A matrix is utilized to demonstrate these inter-relationships.

In this activity, students will be using a 4 x 4 matrix (matrices can be as simple as 2 x 2 or as complex as 12 x 12). The matrix has squares or cells to display how events have an inter-relationship to one another. Thus, a 2 x 2 matrix has four cells, a 4 x 4 matrix has 16 cells, a 10 x 10 matrix has 100 cells, etc. As you will notice, some cells are crossed out. This is where the same factor overlaps with itself. The purpose of the matrix is to identify how different factors inter-relate to one another.

Objectives: Students will be able to . . .

1. Categorize facts from different sources concerning hunger.
2. Identify 2 variables that impact each fact.
3. Analyze the interactions in an inter- relationship matrix.
4. Create a personal hunger matrix.
5. Develop a 4 x 4 inter-relationship matrix using the fact cards pertaining to world hunger.

Materials:

1. Copies of Handouts-- Individual Hunger, and Inter-relationship matrix.
2. Copies of the fact cards.

DAY ONE - ACTIVITY A

Procedure:

1. Hand out the individual hunger matrix. Explain how each topic interacts with the other topics. Ask students for their input concerning what other personal ideas they would include in the cells.
2. Give each student a copy of a blank individual hunger matrix and have them write their own explanations in each cell.
3. When this is completed, have the students share their matrices with the rest of the class and compare their ideas.

DAY TWO - ACTIVITY B

Procedure:

1. Teacher should draw a world hunger matrix on the board or butcher paper.
2. Have class discuss the four variables.
3. Divide the class into groups of three or four students each.
   Distribute a set of fact cards and a blank world hunger matrix to each group.

(**NOTE TO THE TEACHER**: The fact cards should be cut apart before distributing to the groups. The titles at the top of each page should not appear with the fact cards. These titles represent the authors' opinions concerning the matrix cells into which the fact cards would best fit. The students may have other equally justifiable opinions.)

Inter-relationship Matrix
Individual Hunger

"WHY JOHNNY IS HUNGRY"

	hunger	home	school	food choice
hunger	X	I got up late and didn't have time to fix anything for breakfast.	I was late for school and the cafeteria had stopped serving breakfast.	There were apples in the refrigerator, but I don't like to eat apples.
home	Mom didn't go shopping last night, so there wasn't anything quick to fix that I like to eat.	X	I'd like to bring my lunch to school, but Mom won't buy the the things that I like.	Mom only buys health foods and vegetables. I don't like that kind of food.
school	The portions served in the school cafeteria are too small for 7th grade students.	Mom insists that I eat the school lunch.	X	I don't like the kind of food that is served in the cafeteria.
food choice	The soda and candy bar that I bought from Circle K wasn't enough to fill me up.	Mom's on a diet and will only fix healthy food. I don't like to eat what she fixes.	The choices of what to eat in the school cafeteria are limited. I don't like the food.	X

Inter-relationship Matrix

╳			
	╳		
		╳	
			╳

Inter-relationship Matrix
World Hunger

	hunger	population	land use	food choice
hunger	X			
population		X		
land use			X	
food choice				X

Each group will then identify which facts would go into each blank cell. When each group has completed their matrix, have the students share and compare their results.

4. Through discussion, help the class see the relationships between the ineffective use of land, the inequity in the distribution of food, and the impact of personal food choices. Emphasize that the matrix only helps to identify the factors and inter-relationships that impact on world hunger. A matrix does not offer solutions.

DAY THREE - ACTIVITY C
LONG ARM EATING

Materials:

(a) Tag board
(b) Copies of "Feast or Famine"
(c) Construction paper
(d) Copies of poetry and quotes
(e) Tape
(f) Cookies

Purpose:

- To demonstrate the need for cooperation in solving the world's hunger problem.

Procedure:

1. Prepare arm tubes ahead of time. The tubes should be long enough to slip over the arms from the wrists to the upper arms. The purpose is to keep the elbows from bending.
2. Class Demonstration: Have five students sit in front of the room. Place the tubes on both arms of each student. Place a plate of cookies on a table in front of the students.
3. Inform students they may eat the cookies, but they may only use their hands (no picking up cookies with their mouths!) and must not bend their elbows. Tell them that they have 5 minutes in which to eat all of the cookies.
4. After 5 minutes stop the activity. Initiate class discussion regarding feelings, observations, etc.
5. Give students the handout "Feast or Famine". Read individually or orally, then discuss. After reading and discussing the story, students may want to try the activity again.
6. Have students read the poetry and quotes section. Have the class discuss the selections.

POPULATION AND FOOD CHOICE FACT CARDS

Abundance not scarcity best describes the supply of food. There is enough grain produced to feed every person in the world more than 3000 calories per day.	The average North American consumes 2000 lbs. of grain a year. Only 150 lbs. is eaten directly as grain or flour. The rest is consumed as meat, eggs, milk and alcoholic beverages.	A 10 % reduction in beef consumption in the United States would free up enough land, water, and energy to feed 60 MILLION people.
If the U.S. population would reduce their consumption of meat by 10%, there would be over 12 million tons of grain available every year for human consumption.	Today's livestock population in the United States consumes enough grain and soybeans to feed over 5 times the entire human population of the United States.	The meat eating class pays a costly health price with the diseases of affluence: strokes, heart disease, and various types of cancers.

POPULATION AND LAND USE FACT CARDS

In Central America, farmers who own < 10 acres, cultivate 72% of their land. Farmers with > 86 acres, cultivate only 14% of their land.	In 1974, the USDA reported that 5.5% of all farms in the United States controlled more than 50% of all the farmland.	In 1975, less than 4% of the population in 83 countries controlled nearly 80% of the farmland.
By the 1990's, new farming technologies (new seeds, chemical fertilizers, pesticides, etc.) had displaced the traditional farming methods of millions of 3rd world farmers.	In the 1980's, 1% of the farmers in the United States received 60% of net farm income.	China feeds its population using only 1/8 of the cropland per person that is used in the United States.
Export agriculture needs cheap labor and control over large tracts of land.	In today's world, food production is increasing faster than population.	

LAND USE AND FOOD CHOICE FACT CARDS

An acre of land devoted to corn and sorghum can produce over 1200 lbs. of grain per year.	For every acre of American forest that is cleared for housing, roads, etc., seven acres of American forest are cleared for livestock production.	If used to produce cattle feed, one acre of land produces around 50 lbs. of beef per year.
One acre of land can produce 20,000 lbs. of potatoes per year.	A typical 4 oz. burger made from rain forest beef represents the destruction of an area of rain forest the size of a small kitchen (55 sq. ft.)	Meat oriented diets demand the use of more than 95% of our nation's soil.
Vegetarian oriented diets demand the use of only 5% of our nation's soil.		

FOOD CHOICE AND HUNGER FACT CARDS

When we use livestock to "pre-process" our grains, we lose 90% of the grain's protein, up to 96% of its calories, and 100% of its fiber and carbohydrates.	By using livestock to "pre-process" our grains, we obtain less than 10% of the calories available to feed people as would be available if the grain were eaten directly.	It takes 16 pounds of grain to produce one pound of beef.
It takes one pound of grain to produce one pound of bread.	The cattle of the world eat enough food to equal the caloric needs of 8.7 BILLION people, almost 2 times the current human population on earth.	World wide, over 40% of earth's grain goes to feed livestock.

LAND USE AND HUNGER FACT CARDS

25 yrs. ago, livestock consumed 6% of Mexico's grain. Today, livestock consume nearly 1/2 of all of Mexico's grain.	70% of the grain produced in the world is consumed in the U.S., western Europe, Japan, and Australia. Most of it is used to feed livestock.	Export crop production is growing at a much faster rate then food crop production. Multi-national agribusiness and local elites benefit from export agriculture.
Continent-wide, Africa has more than 100 million people who lack the food necessary to maintain health and normal physical activities, such as planting or harvesting.	80% of the corn grown in the United States is consumed by livestock.	95% of the oats grown in the United states is fed to livestock.

POPULATION AND HUNGER FACT CARDS

At least 20% of all Mexicans are malnourished.	Every year, the number of people who die of hunger equals the number of people who would die in 300 jumbo jet crashed.	In Asia and Africa, **100,000** children go blind each year, due to a deficiency of vitamin A.
Everyday, **35,000** people die of starvation. 3/4 are children under the age of five years.	Nearly **14 million** children die each year from diarrhea and poor nutrition.	Every year, over **400 million** people suffer from hunger, starvation, and malnutrition.
15-20 million people die each year from hunger related diseases. 3/4 are children.	The number of people unable to grow enough food or earn enough money to buy food, will increase by **600 million** by the year 2000.	Nearly 20 million Americans are underfed.

FEAST OR FAMINE?

There once was a man who lived an average sort of life. It wasn't a bad life, but it wasn't necessarily a very good life either. He lived just a rather ordinary life, and had a rather ordinary job, as the manager of a grocery store. One night while the man was sitting in his lounge chair, watching television, something rather extraordinary happened. One minute, he was waiting for the start of the Jay Leno Show, and the next minute, he was standing before very large, shining, golden gates.

The man felt somewhat confused. He pinched his leg. He felt the pinch, so he must be awake. He didn't quite know where he was, or what he should do. So he sat down on the ground and waited. He noticed that the ground was soft, covered with thick emerald green grass. After a short time (though it seemed like eternity to him!), the gates slowly opened. The man noticed that they opened smoothly, with no creaking.

Standing just inside the gates, was a woman. She was not an old woman, but she was somehow not a young woman either. She was dressed in a long, white, flowing robe with a deep green sash belted around her waist. She smiled, and spoke, "Welcome brother. My name is Gaia, and I will be your escort here in this world." The man was so stunned, he could not speak. He just nodded his head. Gaia held out her hand to him, "Come", she said quietly, "Let me show you around."

The man took her hand and followed her through the gates. Inside, he gazed around in wonder. There were flowers, trees, and bushes of all kinds. Some he recognized, but some he did not. There were birds of all colors and sizes, all singing different songs. Yet, somehow, all in harmony. They walked down a wide path, toward a small hill. After a while, they reached the crest. Down, in the valley below, were two large, beautiful mansions. Both were gleaming white, with turrets and glistening, multi-colored, multi-paned windows.

The single path branched into two, each leading to one of the mansions. One path appeared well-used. The other path appeared to be seldom trod upon. Gaia turned to the man and said, "I will show you both mansions. Which one would you like to see first?" The man nodded toward the well-worn path. Upon reaching the mansion, the man was amazed at the splendor of the various rooms.

Gaia led the man to a dining room. There he saw a large group of people sitting around a huge pot. The pot contained a wonderful smelling soup. His mouth watered as the aroma reached his nostrils. Each person around the pot held a large spoon. Each spoon had a very long handle. The handles were long enough to reach the pot, but so long that the people could not reach their own mouths to eat. The people were crying desperately. Their cheeks were sunken, and their clothes hung upon their bony frames. They were famished and suffering greatly. Gaia looked upon the people with sadness.

"Would you like to see the other mansion now?", she asked. The man dumbly nodded his head. Upon reaching the second mansion, the man was again amazed at the splendor of the various rooms. This second mansion was equally as beautiful as the first. Again, Gaia led the man to a dining room. There, again, was a group of people sitting around a huge pot. Again, each person had a spoon with a very long handle, the very same type of spoon as the people in the first mansion. However, the people in this mansion were happy, laughing and apparently well nourished. The man looked at Gaia in bewilderment. "Do you understand what is going on here?", Gaia asked quietly. The man shook his head. Gaia explained, "In this mansion, the people have learned to feed each other."

Gaia slowly waved her hand in front of the man's face. Immediately, he was back in his lounge chair, in front of his television set. Jay Leno was introducing his first guest.

The man pinched his leg. Yes, he was awake and sitting in his own living room. He slowly shook his head in bewilderment. His strange experience seemed so real. What could it mean? Slowly, a realization seeped into his awareness. He thought about his job at the grocery store. He became acutely aware of the vast amount of food, baked goods and produce, that he thoughtlessly threw into the trash dumpsters every day. With a heavy, sick feeling in his heart, the man thought of the charity kitchen that he passed every day on his way to work. He remembered the long line of children and adults waiting patiently for a meal. Maybe, he thought, just maybe . . .

(Adapted from a traditional story related in *Diet for a new America*)

POETRY AND QUOTES

"There shall be peace on earth but not until
All children daily eat their fill
Go warmly clad against the winter wind
And learn their lessons with a tranquil mind
And thus released from hunger, fear and need
Regardless of their color, race or creed
Look upward smiling to the skies
Their faith in life
Reflected in their eyes."
-United Nations Woman's Guild

There is a destiny that makes us brothers,
None goes his way alone--
All that we send into the lives of others
Comes back into our own."
-Author Unknown

"Think of the fierce energy concentrated in an acorn! You bury it in the ground, and it explodes into a giant oak! Bury a sheep, and nothing happens but decay!"
-George Bernard Shaw

"You put a baby in a crib with an apple and a rabbit. If it eats the rabbit and plays with the apple, I'll buy you a new car."
-Harvey Diamond

If you understand,
things are just as they are;
If you do not understand,
things are just as they are
-Zen Verse

"We are part of the earth and it is part of us.
The perfumed flowers are our sisters;
the deer, the horse, the great eagle,
these are our brothers.
The rocky crests, the juices of the meadows,
the body heat of the pony, and man--
all belong to the same family.

So, when the Great Chief in Washington sends word
that he wishes to buy our land, he asks much of us. . .

If we decide to accept, I will make one condition:
The white man must treat the beasts of this land
as his brothers.
I am a savage and do not understand any other way.
I have seen a thousand rotting buffaloes on the prairie,
left by the white man who shot them from a passing train.
I am a savage and I do not understand how the smoking
iron horse can be more important than the buffalo
that we kill only to stay alive.

Where is man without the beasts?
If the beasts were gone, men would die
from a great loneliness of spirit.
For what happens to the beasts
soon happens to man.
All things are connected.
This we know.
The earth does not belong to man;
man belongs to the earth.
This we know.
All things are connected
like the blood which united one family.
All things are connected.
Whatever befalls the earth, befalls the sons of the earth.
Man did not weave the web of life,
he is merely a strand in it.
Whatever he does to the web, he does to himself."
-Chief Seattle, 1854

The frog does not drink up the pond in which he lives.
-Indian Proverb

Do not try to satisfy your vanity by teaching a great many things. Awaken people's curiosity. It is enough to open minds; do not overload them. Put there just a spark. If there is some good inflammable stuff, it will catch fire.
-Anatole France

SUGGESTED ADDITIONAL READINGS

Bello, W. (1989, February). Brave new third world.strategies for survival in the global economy. (Food First Development Development Report No. 5). San Francisco: The Institute for Food and Development Policy.

Bralove, M. (1974,October3). The food crisis : the shortages may pit the "have nots" against the "haves". Wall Street Journal, p.20.

Brody, J.E. (1975). Give us this day. New York: Arno Press.

Durning, A. (1990, November-December).How much is enough? World Watch, 3 (6), 12-19.

Food and Agriculture Organization. (1974). Agricultural development and employment performance:a corporate analysis. (Agricultural Planning Studies No.18, p.124).

Hur, R. & Fields, D. (1984). Are high-fat diets killing our forests? Vegetarian Times.

Lappe, F.M. (1982). Diet for a small planet. New York : Ballantine Books.

Lappe, F.M. & Collins, J. (1977). Food first : beyond the myth of scarcity. Boston: Houghton Mifflin Company.

Lappe, F.M. & Collins, J. (1986). World hunger.twelve myths. New York: Grove Press Inc.

Lappe, F.M. & Schurman, R.(1988,September). The missing piece in the population puzzle. (Food First Development Report No.4). San Francisco: The Institute for Food and Development Policy.

Lefferts, L.Y. & Blobaum, R. (1992,January-February). Eating as if the earth mattered. E Magazine 3 (1). 31-37.

Lowe, M.D. (1990,May-June). Organic farming gets some respect [Review of Alternative Agriculture]. World Watch 3, (3) 39-40.

Maidenburg, H.J. (1973,July 1). The livestock population explosion. New York Times, p.1.

McKisson, M. & MacRae Campbell, L. (1990) Our divided world: endangered species: their struggle to survive. Tucson: Zephyr Press.

McKisson, M. & MacRae Campbell, L. 1990). Our divided world: poverty, hunger and overpopulation. Tucson: Zephyr Press.

Resenberger, B. (1974, October,25). Curb on U.S. waste urged to help the world's hungry. New York Times.

Resenberger, B. (1974, November 5). World food crisis: basic ways of life face upheaval from chronic shortages. New York Times, p.14.

Robbins, J. (1992,January-February). Can earth survive the Big Mac attack? E Magazine, 3 (1), pp. 39-43; 60-61.

Robbins, J. (1987). Diet for a new America. Walpole, N.H.: Stillpoint.

Simon, A. (1975). Bread for the world. New York: Paulist Fathers Inc.

Turner, T. (1992, January-February) [Interview with Francis Moore Lappe] The world according to Francis Moore Lappe. World Watch, 3 (1), 12-15.

U.S. Department of Agriculture. (1974). Our Land and Water Resources Miscellaneous Publication No.1290, p.321). Washington, D.C.: Economic Research Service.

GO FLY A KITE!

(Grades 5-8)

By Rhonda Gross

INTRODUCTION

Teachers teach what they know. I'll use my team-teacher as an example. He has a tremendous background in the Physical Sciences. When he isn't boring the staff by explaining why trees don't make wind, he's teaching his one true love - physics! Physics in math, Newton's laws in grammar, art and even P.E. You name it, he can incorporate physics into it!

Classroom teachers use their personal interests and educational backgrounds because it is natural and comfortable to do so. It is disconcerting for many teachers to attempt to teach something with which they aren't familiar. This hesitancy is a very interesting paradox because most educators concur that their expertise, some will even say gift, of teaching isn't dependent upon their knowledge of a particular subject. In other words, teachers believe that they possess the natural ability to take any subject, read a few important points about the basics, and then break it down into understandable parts for their students. Granted, some teachers may be better at a specific grade level, or have the expertise to make the subject more interesting. Good educators, however, know that if they are placed in a position where they have no access to lesson plans, curriculum, or a copying machine, they can still teach well, if only by the seat of their pants!

My challenge to you is to take a risk, and introduce a unit of study into your classroom of which you know very little. The truly brave might even ask their students what they want to learn. Take this first step in the STS "Learning Spiral." Your class will then set out on a journey where the final outcome is unknown. The following activity was one of my first experiences with the "Learning Spiral." My students wanted to build kites, big fancy kites! I didn't know anything about kites, but I stuck my neck out and we learned together. Your class may choose to learn something else, but the following steps in this unit are basic to any "Learning Spiral Lesson."

KITE BUILDING

Length of Unit:

- Two one hour sessions per week for five weeks. Many students voluntarily spent their lunch recesses flying kites.

Objectives:

Students will . . .

1. Research kite design and basic aerodynamics
2. Use varied math skills to design a kite
3. Employ problem solving strategies to create a kite that is flight worthy
4. Evaluate design choices to modify existing kites or develop new ones

CLASS PERIOD ONE

Introduction:

Tell your students that you want their input as to what they will be learning for the next four weeks during this class period. Set some parameters. I explained and wrote the following headings upon the board: must be something about flight, hands-on, can include little or no competition, must incorporate group learning, and collectively it can not cost the science budget more than $30 dollars. Your parameters may be different, but be honest about what you are capable of and willing to do.

Brainstorm activities about flight and write them down under that heading. Allow for plenty of time, as your students will amaze you with a large variety of topics and activities related to flight. Begin to narrow down the blackboard list by transferring anything under the flight heading that can be made into a hands-on activity, to the hands-on heading. Ask the class if any of the hands-on activities can be made to be non competitive and place a star by these. Underline any of the activities that can also be done in small-groups. At this point your class may already know what they want to learn, or they may still have a list of several starred and underlined activities. Usually the cost factor or a class vote will narrow the field to one topic. Be flexible concerning the cost aspect of this activity. My students were willing to bring in some of the kite supplies to keep the cost down to $30 dollars. If your class wants to learn about hot air balloons and then take a ride, don't just say no it's too expensive. Assign a few students to do a feasibility study on cost, availability, and possible revenue generating alternatives. This is good modeling of what actually happens in the corporate world.

CLASS PERIOD TWO - EXPLORATION

Materials:

(a) Obtain a variety of kite building books from the library. I like the how-to books in the juvenile section the best. Be sure to include books on oriental kites
(b) Graph paper
(c) Rulers for each group
(d) 5 copies each of several basic kite designs (square box, triangle box, basic T, etc.)

Procedure:

- Allow the students to choose a partner and pass out a kite book to each group. Let them spend the period looking through books and at the basic design sheets. Provide them with graph paper and rulers. Be available to answer questions about ratios and scale drawings. Guide students toward various kite designs that fit their different levels of abilities. But keep in mind that many low academic achievers can be mechanical wizards.

CLASS PERIOD THREE AND FOUR - EXPLORATION CONTINUED

Materials:

(a) Wood dowels or balsa strips from a hobby or hardware store
(b) Plastic trash bags
(c) Newspapers, and tissue paper for covering
(d) Clear strapping tape
(e) Water and bucket
(f) Exact-o-knives ®
(g) Small saws borrowed from the shop teacher
(h) Kite string
(i) Hot glue gun
(j) Fabric or plastic strips for tail (Home Economics teacher can help out with this)
(k) Scissors
(l) Rulers
(m) One large garbage bag for each group to store their unfinished kite in.
(n) Two or three parent helpers if possible
(o) Three 4 foot by 8 foot tables

Procedure:

The groups will finish their kite designs on graph paper, select kite materials, and begin building their kites. Station a parent helper and Exact-o-knives® at table one since the students will need help in making notches in the kite dowels. Have another parent supervise the use of the small saws for cutting lengths of dowels at table two. The third table will have a parent helper available to supervise the use of the hot glue gun on cross supports, and kites with newspaper coverings.

If a group selects a kite that has bowed crossbeams, have a water bucket or sink available to soak and soften the wood. The teacher should not solve specific design problems, encourage the groups to do research or ask others in the classroom how they solved a particular problem.

Box kites will not need a tail, but most others do. Each group should start with three times the length of their kite in plastic or fabric. After testing their kites the groups will have to determine whether a change in tail length will help their kites' stability.

There might come a time during a "Learning Spiral Lesson" when the teacher will feel overwhelmed or out of his or her league. At this point in this activity my students began asking me questions that I was not capable of answering. To solve this problem, I found someone, who had built kites and knew something about aerodynamics, to help me. This plan of action was so successful I know that I will continue to seek the help of experts during other types of classroom investigations.

CLASS PERIOD FIVE - EXPRESSION

Materials:

(a) Finished kites
(b) String
(c) Large field
(d) Extra lengths of tail

Procedure:

1. Assemble the class on the school grounds.
2. Begin the class period explaining the safety rules of kite flying: stay away from power lines, don't fly kites in an electrical storm, and don't chase a kite into the street.
3. The student groups will try to get their kites airborne. Some will be successful during the first attempt, and others will only need the length of the tail adjusted to be successful.
4. There may be several groups with a kite that will not fly. Encourage them to look at the designs of other kites, and consider possible adjustments to their kite to make it flight worthy.

CLASS PERIODS SIX AND SEVEN

Ask the students to list any questions or information that they would like to know about kites and flight. They have built something that flies. It is now time to learn why it flies. Teachers don't have time to find all the information that students want to know about aerodynamics and flight. Let the students be the teacher and researcher instead.

Divide the class into teacher-researcher groups and assign to each group one of the topics or questions that were listed at the beginning of the class period. Each of the groups must research their assigned topic, and present it in an interesting way to the rest of the class. They will have two class periods to do the research and get the presentations ready. All members of the group must participate in the presentation. Encourage the groups to use unique and creative way to present their research, with such diverse forms of expression as a play, bulletin board, or song.

CLASS PERIODS EIGHT AND NINE - LABELING CONTINUED

The teacher-researcher groups will present their assigned aerodynamic topic. Motivate other class members to pay close attention by either giving a quiz, or requiring a filled out evaluation form for each presentation.

CLASS PERIOD TEN - APPLICATION

The students will use the knowledge gained from the presentations to improve their kites. Some students may want to build a new kite or experiment with a design of their own. My class decided to select certain kites for goofy awards-most colorful, strangest shaped, highest flying, and oddest building materials were a few examples. We also hung our kites from the classroom ceiling during parent teacher conferences.

HEALTH CHOICES FOR LIFE

(Grades 5-8)

By Rhonda Gross and Teresa Olson

INTRODUCTION

HEADLINES, HEADLINES! The rate of sexually transmitted diseases among teenage girls has increased 400 percent since 1965. Staphylococcus aureus, Salmonella, and Clostridium perfringens together cause 90% of the food poisoning cases in North America. More than 1.5 million people in the United States are infected with HIV which causes AIDS. Headlines concerning communicable diseases can be found daily in the newspaper.

Educators have the difficult task of arming their students with information which will enable them to fight the spread of communicable diseases. This information must be conveyed in a non-emotional and non-moralizing manner. The purpose of this article is to provide the teacher with twelve usable activities about the transmission, prevention, and causes of communicable diseases. These activities were designed to be non-judgmental so that students can, after receiving just the facts, begin to form their own health choices for life.

TOPICS COVERED IN THIS ARTICLE

Introduction to the microscopic world-the good, the bad, and the ugly:

A Eating bacteria
B. Decomposers at work
C. What's a million?
D. Reproductive rate of bacteria experiment

How communicable diseases are spread:

E. Can you catch it from the toilet seat?
F. Effects of antiseptics and antibiotics on bacteria
G. Food preservation

A study in immunology:

H. The Black Death of the Fourteenth Century
I. Perry Paramecium runs for mayor

People can make a difference:

J. Big heroes in a small world
K. Career scavenger hunt
L. My Rules for Healthy Living

Objectives:

Students will . . .

1. Make frozen yogurt.
2. Complete an experiment on the decomposition of newspapers by soil bacteria.
3. Comprehend the magnitude of the number one million.
4. Chart the reproductive growth rate of bacteria.
5. Properly inoculate and handle a culture dish.
6. Explain the variety of conditions affecting the growth of bacteria.
7. Conduct an experiment concerning the effects of antiseptics and antibiotics on bacteria.
8. Research bacterial food poisoners and present information in an oral report.
9. Participate in a role-playing activity about the fourteenth century plague.
10. Use newspapers and a bulletin board to evaluate good health choices.
11. Design a poster describing the accomplishments of a historical scientific figure.
12. Use the local phone book as a resource to find careers in health-related fields.
13. Evaluate material learned, and form a personal plan for healthy living.

INTRODUCTION TO THE MICROSCOPIC WORLD

Microorganisms are our unseen companions, and are part of the balance of all the ecosystems. Bacteria act as decomposers, breaking down dead plant and animal matter, and return it to the soil. Some microorganisms give familiar foods their good taste and appearance. Microorganisms also cause diseases and spoil food. This is why they can be called the good, the bad, and the ugly.

A. EATING BACTERIA: HOW TO MAKE FROZEN YOGURT

Yogurt gets its taste and texture from helpful bacteria. Yogurt was eaten in the Middle East 2,500 years ago. It is made from heated milk containing bacterial cultures. This activity is very easy and inexpensive to do.

Materials for 30 students:

(a) 1 half gallon of milk
(b) 1 eight ounce carton of plain yogurt with active cultures (Dannon® or Yoplait® are two brands that do.)
(c) Hot plate
(d) 3 quart size pan
(e) A thermometer
(f) 2 wide-mouth Thermos® bottles
(g) 1 small (4 ounce jar) of strawberry jam
(h) 30 small (3 ounce) paper cups
(i) 30 popsicle sticks or straws
(j) 2 large spoons
(k) Freezer

Procedure:

DAY ONE

1. Wash hands.
2. Heat milk to 82° C in the 3 quart pan.
3. Let milk cool to 48° C, and stir in the 8 ounce cup of yogurt and the small jar of strawberry jam.
4. Pour mixture into the two Thermos® bottles and close lids.
5. Allow the mixture to set for four hours at room temperature.
6. After four hours, refrigerate the mixture until the next day.

DAY TWO

1. Instruct all students to wash their hands with soap and water.
2. Each student should write his or her name on the side of a small paper cup.
3. Students will take turns using a spoon to fill up their small paper cup with yogurt.
4. Stick a popsicle stick or straw into the center of each yogurt filled cup.
5. Freeze overnight.
6. Peel off the paper cup, and enjoy eating frozen yogurt bars.

B. DECOMPOSERS AT WORK

Bacteria and fungi live in soil and can decompose newspaper, as well as other living and non living things. In this experiment the students will see bacteria function as part of the cycle of life in our environment.

Materials needed:

(a) 2 small plastic buckets
(b) sand
(c) potting soil
(d) newspaper
(e) water

Procedure:

1. Fill one bucket 2/3 full with sand.
2. Fill the other bucket 2/3 full with potting soil
3. Tear two pieces of newspaper into two strips 3 inches wide by 6 inches long.
4 Bury one strip of newspaper in the sand and one strip in the potting soil. Keep one end of each of the newspapers sticking out of the soil and sand.
5. Water the soil and sand in the buckets daily, keeping the soil and sand moist.
6. After one week has passed, remove the newspapers.
7. The students will find that the bacteria living in the potting soil have partially decomposed the newspaper. There won't be any change in the newspaper that was buried in the sand because decomposing bacteria doesn't live in sand.

C. WHAT'S A MILLION?

When discussing bacteria we often talk in terms of millions of bacteria. It is hard for students and adults as well, to imagine a million of anything. This activity is designed to help your students understand how much a million is.

Anticipatory Set:

Ask the students to list five things that they feel would be almost impossible to count. Collect the papers, read and discuss the answers.

Materials:

(a) Two reams of paper
(b) Clock
(c) Pencil

Procedure:

Borrow from the office two reams of paper for a total of 1,000 sheets. Instruct one student in the class to make 1,000 pencil marks on one of the sheets of paper while the rest of the class counts the marks, and keeps track of the length of time it takes. When the student is finished, explain to the class that they would have to put 1,000 pencil marks on all of the 1,000 sheets of paper to make a million pencil marks. Speculate how long it would take the class to do this. Return the other 999 sheets of paper to the office.

The class might want to collect one million aluminum pop tops. These pop tops can then be donated to the Ronald McDonald Children's Charities® which is an organization that receives money from local businesses for every pop top collected.

HOW COMMUNICABLE DISEASES ARE SPREAD

We are surrounded by microorganisms. Some are carried to other parts of the world by atmospheric currents, and others live in water or food that we eat or drink. Animals, insects and humans are carriers of bacterial diseases. Even soil is the home to vast hosts of microorganisms.

D. REPRODUCTIVE RATE OF BACTERIA EXPERIMENT

Purpose:

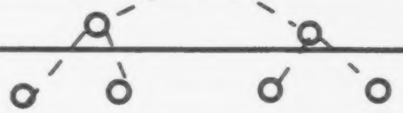
- To investigate the potential reproductive rate of bacteria.

Materials:

(a) Lab sheet
(b) Pencil

Procedure:

One bacterium can divide into two every twenty minutes. If favorable conditions continue then those two bacteria can continue to divide every twenty minutes. This lab sheet will show the students how millions of bacteria can grow from one bacteruim.

TIME	REPRODUCTIVE RATE OF BACTERIA	NUMBER
:20 MINUTES		1
:40 MINUTES		2
1 HOUR		4
1:20 MINUTES		
1:40 MINUTES		
2:00 HOURS		
2:20 MINUTES		
2:40 MINUTES		
3:00 HOURS		
3:20 MINUTES		
4:00 HOURS		

E. CAN YOU CATCH IT FROM A TOILET SEAT?

Anticipatory set:

Ask the class if anyone in the class has seen a sign in a restaurant bathroom which says, "Employees must wash hands." Discuss why this procedure is necessary for food handlers. Unwashed hands can spread disease. Explain to the students that they are going to become "Disease Detectives," and search for disease causing bacteria around the school.

Materials:

(a) One sterilized culture dish for each student. These dishes must be prepared in advance. Wash the culture dishes on the top rack of an electric dishwasher before filling each dish with agar. Agar is an inexpensive growth medium for bacteria, and is available through biological supply companies. Instructions for mixing and sterilizing it are included with the agar. Use a grease pen for marking the student names and the location on the culture dish where the bacteria sample was collected from.

(b) Sterile cotton swabs.

(c) Warm dark place to grow the bacterial cultures.

Procedure:

(**NOTE TO THE TEACHER**: Emphasize to the class the importance of inoculating a culture dish in the following manner. Failure to follow the steps described will result in a contaminated culture dish and a ruined experiment. Demonstrate the following steps.)

1. Get a sterile culture containing agar from the box marked STERILE CULTURE DISHES.
2. Use a grease marking pen to put your name on the outside BOTTOM of the culture dish.
3. Open the dish by removing the top. Do not touch any area inside the top or bottom of the culture dish.
4. Place the top of the dish FACE UP on the table.
5. Remove a sterile cotton swab from the swab container.
6. Rub the swab over a surface which you want to collect bacteria. Choose a doorknob, lunch tray from the cafeteria, or anything else around the school.
7. Lightly rub the inoculated cotton swab across the agar surface of the culture dish. Cover as much surface as possible.
8. Replace the top. Avoid touching any area on the inside of the top or bottom of the culture dish.
9. Write the location telling where the bacteria sample was taken from on the outside bottom of the culture dish.
10. Place your culture dish in the warm dark place that you have set aside. The culture dish must be placed UPSIDE DOWN. Since this keeps the moisture produced by the bacterial metabolism from condensing and raining back down on the agar.

After the inoculation demonstration is completed, ask each class member to find some place on the school grounds to take a bacteria sample using a sterile cotton swab, and then inoculate a sterile dish. Have students examine the bacterial growth in the culture dishes daily.

Evaluation:

- After a week has passed the students should be able to answer the following questions while comparing all of the inoculated culture dishes.

Question 1. Explain the growing conditions of where you found your bacteria. Was the location wet, dry, hot, or cold?
Question 2. On which surfaces at school do you think bacteria grow best?
Question 3. Explain why you think that bacteria didn't grow in some of the culture dishes.
Question 4. Whose culture dish had more than one kind of bacteria growing in it. How did you know that it had more than one kind?

F. EFFECTS OF ANTISEPTICS AND ANTIBIOTICS ON BACTERIA

Antiseptics are chemicals used to control the growth of disease causing bacteria on the surface of the skin. You have probably used an antiseptic after cutting yourself. Antibiotics are formed from molds, the most well known antibiotic is penicillin. Disease causing bacteria are stopped or inhibited by antibiotics that are taken either orally (swallowed), intravenously (through the bloodstream) or topically (rubbed on the skin.) In this experiment the effects of different antiseptics and antibiotics on bacterial growth will be demonstrated.

Materials:

(a) Six sterile culture dishes with agar (see activity E for correct procedure on handling and inoculating culture dishes.)
(b) Small cotton balls
(c) Cotton swabs
(d) Dark warm place for incubation
(e) Grease pen for marking culture dishes
(f) Ruler
(g) Forceps
(h) Small paper cups
(i) Any four of the following antiseptics: mouthwash, iodine, alcohol, hydrogen peroxide, Mercurochrome®, and/or Merthiolate®.
(j) Four antibiotics such as penicillin, tetracycline, streptomycin, and erythromycin. These can be obtained from doctor's samples. CAUTION: bring only one pill of each kind of antibiotic into the classroom. Warn the students that some people react severely to antibiotics and that they should not take anyone else's medication. To prepare the antibiotics for this experiment, open each pill and empty its contents into a small cup. Add 1/4 cup of water in each cup to dissolve each of the antibiotics.

Procedure:

1. Use a grease pen and ruler to divide the BOTTOM of the culture dishes into four equal sections. Mark each section A, B, C, or D on each culture dish.
2. Have a student rub a sterile cotton swab along the inside of his cheek.
3. Raise the lid of the culture dish and rub the swab over the entire agar surface. Close the dish and throw the used swab into the trash. Follow the same procedure with two other culture dish. Write "mouth" on the outside BOTTOM of the three inoculated culture dishes. Mark one dish "antiseptics," one dish "antibiotics," and one dish "control."
4. Have another student inoculate three culture dishes after rubbing the sterile cotton swab along the surface of his or her arm. Write "arm" on the outside BOTTOM of these three culture dishes. Mark one dish "antiseptics," one dish "antibiotics," and one dish "control."

5. Use forceps to dip just a small area of a cotton ball into one of the antiseptics. Open the "mouth-antiseptic" culture dish and carefully place the cotton ball in one of the four divided sections. Dip another cotton ball into the same antiseptic and place it in one of the four divided sections of the "arm-antiseptics" culture dish.
6. Repeat step 5 for three more antiseptics and four more antibiotics. Wash the forceps with water between each antiseptic or antibiotic cotton ball dip. When finished there will be a mouth-antiseptic culture dish contain four cotton balls filled with four different antiseptics, arm-antiseptic dish containing four cotton balls with four different antiseptics, mouth-antibiotic dish containing four cotton balls with four different antibiotics, and arm-antibiotics dish containing four cotton balls with four different antibiotics.
7. Do not put any cotton balls into the two culture dishes marked "control." They will be used to show the students how the mouth and arm bacteria will grow without antibiotics or antiseptics.
8. Place the culture dishes UPSIDE DOWN in a warm dark place.
9. Observe the culture dishes after 24 and 48 hours. DO NOT OPEN THE CULTURE DISHES. Record your observations on the lab sheet.

ANTISEPTICS-ANTIBIOTICS LAB SHEET

DIRECTIONS

1. Keep a record of the antiseptics you dipped the cotton balls into, and the section of the culture dish in which you placed them.
2. Examine the growth of bacteria after 24 hours and 48 hours. Look carefully around each of the cotton balls and record your results.

RESULTS

Mouth-antiseptic culture dish	24 hours	48 hours
A		
B		
C		
D		

Mouth-antibiotic culture dish	24 hours	48 hours
A		
B		
C		
D		

Mouth-control culture dish	24 hours	48 hours
A		
B		
C		
D		

Arm-antiseptic culture dish	24 hours	48 hours
A		
B		
C		
D		

Arm-antibiotic culture dish	24 hours	48 hours
A		
B		
C		
D		

Arm-control culture dish	24 hours	48 hours
A		
B		
C		
D		

ANTISEPTICS-ANTIBIOTICS LAB SHEET (Continued)

3. Explain briefly what you found out about antiseptics and antibiotics from this experiment.

4. Which antiseptics and antibiotics prevented or inhibited bacterial growth the best?

Probable results:

Some antiseptics are stronger than others. Some antiseptics will kill most bacteria while others will just slow down their multiplication rate. In this experiment the lack of bacterial growth around certain cotton balls in each section of the culture dishes will show which antiseptic is the most effective in preventing the spread of communicable diseases.

Various antibiotics will have different effects on various types of bacteria. An antibiotic may kill the bacteria, or it may do nothing at all to it. For this reason doctors must know which type of bacteria is causing an infection before they can prescribe the proper antibiotic to help fight that infection. Some antibiotics are called "broad-spectrum" antibiotics because they will kill many different types of bacteria at the same time. In this experiment there will not be any growth of bacteria around the cotton balls dipped in an antibiotic which kills that particular type of bacteria.

CAUTION: Be careful when disposing of used agar. It should not be thrown away where stray pets or small children might eat it. Wash culture dishes thoroughly with soapy water.

G. FOOD PRESERVATION

Several bacteria cause food poisoning. During this activity the students will learn about the most common bacterial food poisoners. Divide the class into groups of four or five members. Assign each group a bacterial food poisoner such as: botulism, salmonella, hepatitis, staphylococcus aureus, and clostridium perfringens. The groups will do research to find the answers to the following questions:

1. What symptoms does your bacterial food poisoner cause?
2. How can this type of food poisoning be prevented?
3. What types of technology are available to stop food spoilage by your bacteria?
4. How was food poisoning by your bacteria prevented in the past?
5. Find out about federal, state and city regulations concerning food handling.

After completing their research each group will present to the class the information that they found out about their bacteria.

A STUDY OF IMMUNOLOGY

Germs are everywhere! How do people survive in this microorganism infested world? Our immune system protects us and keeps us from getting sick.

H. THE BLACK DEATH OF THE FOURTEENTH CENTURY

Background information for this activity:

Bubonic plague is a bacterial disease that has been given the graphic name, "Black Death," because of the darkening of the skin of infected individuals. Infected persons usually die if untreated. The plague was spread to human beings by bites from fleas that were generally infected by rats. There have been outbreaks of the plague since the eleventh century, but the term the "Black Death," refers to the most serious outbreak during the fourteenth century. Twenty three million Europeans died from the Black Death. This was over twenty percent of the entire European population. The Black Death was spread along the trade routes connecting the continents. Africa and Asia were also ravaged by the plague but the death rates in these continents are unknown.

In the year 1665 one sixth of the population of London, England died from an outbreak of the plague. Trade ships brought the plague to San Francisco during the 1800's. Since that time there have been several reported cases of the plague in the United States. Today, because of advances in medical technology, very few people die of the plague.

Eighty percent of the fourteenth century population of Europe did not die from the plague. Half of the population of Europe lived in cities where the infected rats and fleas were. Therefore, if a person lived in the country, he or she would most likely not have been infected. Sailors and merchants along the land and water trade routes had a greater chance of exposure to the disease. The very old and the very young were at greater risk of infection. And the poor who lived in rat infested city dwellings caught the plague and died in the greatest numbers.

Some people were exposed to the plague, but had a natural immunity to it. Their bodies fought off Yersinia pestis, the bacterium that causes the plague. Others got the plague, survived it, and never got it again. They had developed an immunity to the plague. Offspring of parents with a natural or developed immunity are sometimes immune themselves. Factors such as these are a few examples of why the ravage of the plague eventually stops in a specific population.

EXPLORATORY ACTIVITY IN IMMUNOLOGY: "WHY DO SOME PEOPLE GET SICKER THAN OTHERS?"

INTRODUCTION

Start by asking your students to think about the number of days in the last school year that they were sick with illnesses like the flu, sore throat, a cold, lice, measles, or chicken pox. Tell them that they don't have to have an exact idea, but a good general idea. You may have to help them out a bit with statements like, "If you were ill for 2 weeks, that's about 14 days." The question of disorders like asthma and allergies will come up, and they should also be included in the count. Don't make any kind of public record of who spent how many days being ill, as the students will feel sensitive about being pointed out in this way. Ask students to write down the number of days on a scrap of paper, and collect them.

After you have collected their answers, read them aloud without mentioning names of students. The students will begin to see a great deal of variation in the number of days they were ill. Now ask the students to brainstorm possible reasons for this variation between students. They should be able to think of many, including:

- Amount of sleep a student gets on a regular basis.
- Number of people in a household.
- Cleanliness of the household.
- Quality of nutritional intake.
- Emotional nature of the student and their lives.
- Number of family illnesses.
- General health level of parents.
- Amount of stress.
- Presence of smokers in household.
- Participation in regular exercise.
- Personal consumption of alcohol, tobacco, or drugs.
- Quality of social relationships.

Obviously, many of these factors deserve further study. You may wish to develop lessons or units dealing with any one of them. The following role playing game utilizes known health risk factors which contributed to contraction, recovery, or death of individuals living during the age of the Black Plague. Twenty-four students will receive a mystery identity envelope assigning them a persona to portray. The variables that the students will chart will include sex, age, rural or non-rural address, and nutritional history. There is a chart master included in this article to simplify lesson preparation.

(**NOTE TO THE TEACHER**: To prepare for the lesson, make class copies of the chart master, and prepare mystery persona envelopes by copying and cutting apart the following descriptions. Explain to the students that you are going to play a game that will demonstrate factors relating to resistance to disease. You will focus on information that you learned already about the Black Plague. Twenty-four students will receive a mystery identity pass to read aloud.)

1. I am Albert the sailor. I am 35 years old. I go on long sea voyages to earn money. It's very hard work, and they don't feed us very well. I always come back on board for the next trip though, because I blow my money when I'm in port buying liquor, and because I don't know how to do anything else. Some of my jobs are to swab the deck, kill the rats in the hold, and to load the goods we bring on our ship onto the dock for customers to pick up. I'm not feeling very good, but I'm sure it's nothing serious.

Albert has the plague, and because of his long history of poor food, hard drinking, and hard work, he did not recover, and died.

2. I am Darren. I deliver the goods the boats bring into the harbor to the shops that ordered them. I am 40 years old, and a lucky man. I own my own business, so I don't have to work as long as other men. My wife is a wonderful cook and gardener, so we eat as well as the king in his castle. We have a clean home that the cats protect from rats, and we get lots of sunshine and exercise. I believe that's why none of us have ever had the plague. Not everyone is so lucky! Henri the tailor's family has had troubles. That makes me sorry that I didn't help unload his crates of fabric last winter. I was angry because he claimed it was my fault he had rats in his workroom! He said they came in with a shipment I brought from the docks! I told him to shut up and get some cats to take care of them.

3. I am Janet, Darren's wife. I am 35 years old. I love to work in my garden to grow our food. It is not fashionable to have tan skin and dirty hands, but I don't care about that. I care only that my children know how to grow, cook, and eat healthy food. I'm as healthy as can be, and I have never had the plague.

4. I am Michelle, Janet and Darren's 8 year old daughter. My mother is strict but very good to me and my little brother. I have to eat all of the vegetables on my plate, and she won't let me play with very many town children. We have to go to bed early, and get right to sleep! Michelle never gets the plague.

5. I am Henri the tailor. I am 40 years old. I have had a good life and regular meals, because my family has always made beautiful clothing that the rich people will pay us a lot of money for. Times have been tough lately though. Good food is hard to get, because country people are afraid of the plague, and won't come to the city. My wife gives me the best of what we get though, because I am the man, and I must work for all of us. Our house is pretty nice, but some of the workrooms at the shop have rats! I got the plague, and was very sick, but I am better now. I'll never get it again.

6. I am Marie, Henri the tailor's wife. I am 38 years old. I curse the plague! I have done nothing but nurse my sick family with this horrible disease. So many have died, and I am so tired and hungry! It has been hard to get good food because of the plague. When my husband was sick, I had to go and help clean out the workroom. Now, I'm so tired and weak, I'm afraid that I may have the plague too!

Marie had worked so hard caring for her family that she was too weak to resist the disease. She died soon after she got it.

7. I am Anna, Marie and Henri's 5 year old daughter. I have never liked to eat very much. Mamma says I have always been sickly. I got the plague after my Poppa did, and I died very quickly.

8. I am Tony, Anna's older brother. I am 12 years old. I have had a very simple life up to about one year ago. That was when my brother ran off to marry a farm girl. Now I have to work at the shop. Almost everyone in my family has been sick. I wonder if I will be next. Mamma is so sick! I remember all the times she said she wasn't hungry, and I finished her food. She is so weak now, I wish I could go back to those times and make her eat!

Tony never does get the plague.

9. I am Amy. I am Henri and Marie's oldest daughter. I am 20 years old. My husband was a sailor. I have a small cottage in the country with a garden where I wait for him to come back after his long sea trips. We are lucky to live in this village, where good food and clean water are available to everyone. He is with me now, and is sick. I am afraid it is the plague!

Amy catches the plague from her husband, but recovers, and will never have it again.

10. I am David, Amy's husband. I am 25 years old. I am a sailor. I have worked very hard in the last few years to pay for the cottage in the country. I hate my ship captain, because he doesn't feed us well, and he works us to the bone. Soon I will quit, because I feel myself getting weaker from such treatment. Four of my fellow sailors died during the voyage. They had dark bruises all over their bodies. I am not feeling very well, but a week with Amy will make me better.

David doesn't know it, but he has the plague, and he dies.

11. I am Andrea, David and Amy's 6 month old baby. I caught the plague from my father, and didn't want to eat. I couldn't fight off the disease, so I died.

12. I am Joseph. I am 13 years old. I am an apprentice in Henri's shop. It is a good shop to work in. They give me good food, a warm place to sleep, and not more work than I can finish. I am very lucky in many ways. I got the plague, and was very sick, but I got well.

13. I am Dylan, Henri the tailor's 18 year old son. My father and I argued because I wished to marry the lovely Esmerelda, a farmer's daughter. Poppa thought I was too good to be a farmer, but I love farming and my wife. I believe that I did the right thing, because I have not caught the plague, and my bossy father has!

14. I am Esmerelda, Dylan's wife. I am 18 years old. Many people say that life in the country is so boring, but I love it! We have food, laughter, and love! What else do we need? We don't have everything the city has, that's true. For instance, we don't have the plague! I pray to God every night that he will continue to spare our little town. My poppa and my husband continue to say that as long as we keep visitors out, we will be safe.

I never did catch the plague.

15. I am Laura, Esmerelda's Grandmother. I am 52 years old. I am lucky to live in my beautiful village. We have good food and happy times. I never caught the plague, but I am worried about my husband Pierre and my son Jacques. A few months ago they decided to travel to the city to trade our extra food for some spices and cloth. We haven't heard from them since they left.

16. I am Pierre, Laura's husband. I am 55 years old. I am a foolish old man. I came to the city for riches, and got sick with the plague. My son and I are staying with the monks at the monastery. The monks and the nuns are the only ones who will care for the sick now. Every one else is afraid, but they believe they do God's will.

Pierre dies.

17. I am Jacques, Esmerelda's father and son of Laura and Pierre. I am 39 years old. I caught the plague in the city like my father, but I will recover, and never get it again. I am worried about my father, though. How will I tell my mother if he dies? We had such a wonderful life, always enough food, sleep, and work to do. Now we have this trouble.

18. I am Brother Mark. I am 35 years old. When I was a 9 year old boy, I caught the plague, and my family brought me to the monastery. They helped me get well, and I have been here ever since then. I do not fear the plague now, for I am sure that I have been spared to help the poor.

Brother Mark never does catch the plague again.

19. I am Queen Susan. I am 38 years old. I have no intention of ever catching the plague. I will stay in my summer castle, in the country, until the plague is under control. Any of my subjects wishing to discuss matters with me shall sit behind a screen and state their business, from a safe distance. My castle is clean, free of vermin, and the cooks must bathe daily.

Queen Susan never does catch the plague.

20. I am Teresa. I am a governess to the children of the duke. I am 26 years old. I am very poor, but my job has always included three good meals a day, so I am luckier than some. The duke and duchess sent me to the convent for care when I became ill with the plague, and I was lucky. I got well. Many of the people here were not so lucky.

21. I am Michael, and I am 9 years old. I am a chimney sweep in the city. My family is very poor, and we have never had much to eat. I am very sick, and so I am not working today.

Michael dies.

22. I am Sister Marion. I am 45 years old. I gave my life to God when I was very young, and I have lived in the convent most of my life. It is a good life, we have plenty of food, prayer, and rest. We are caring for the sick now, and I am one of the nurses. I was sick with the plague, but have gotten better.

23. I am Princess Sara. I am 14 years old. I'm widely to be believed the prettiest, and healthiest princess in Europe. My mother, Queen Susan, will not allow me to mix with the "common people". That's why I've never caught the disease. Mother says that she will keep me in this castle in the country away from all possible harm, until I marry next year. The king that she picked out for me is kind of an ugly old goat, but at least there isn't any plague in his country and he is very rich.

Princess Sara never does catch the disease.

24. I am Sir Hugo. I am 16 years old. My father recently died of the plague, after a trip to the Holy Land, so now I have inherited his title. We are all afraid of catching the plague. Many are sick and dying in the manor since they brought the disease back with them. I am resting in bed after a serious bout with the disease. They tell me I lived because I've always been well fed and because I am very athletic. I guess the fencing, horseback riding, and hunting helped strengthen me for this time. Now that I've lived through the disease once, I'll never get it again!

WHY DO SOME PEOPLE GET SICKER THAN OTHERS?

(**NOTE TO THE TEACHER**: This chart is intended for student use. Some data has been filled in, to get students started. As students fill in the remaining data, they should begin to see patterns in disease, resistance to disease and recovery from disease. Allow time to discuss their ideas as they share them).

Name	Disease Data	Female Or Male	Age	City or Country	Nutritional History	Infection Information	Other Factors
1. Albert	Died	Male	35	ships, city	poor	probably rats	drinker
2. Darren	Never got	Male	40	city	good	-------------------	rest, sun, exercise
3. Janet							
4. Michelle							
5. Henri	Recovered						
6. Marie							
7. Anna							
8. Tony							
9. Amy							
10. David							
11. Michelle							
12. Joseph							
13. Dylan							
14. Esmerelda							
15. Laura							
16. Pierre							
17. Jacques							
18. Brother Mark							
19. Queen Susan							
20 Teresa							
21. Michael							
22.Sister Marion							
23. Princess Sara							
24. Sir Hugo							

I. PERRY PARAMECIUM RUNS FOR MAYOR!

Use the newspaper to help your students to identify wise choices that will effect their future good health. The newspaper runs a variety of articles related to the prevention and spread of disease. The editorial page will contain discussions concerning the political aspects of AIDS, national health care, and other related subjects. The health and science section might report on a recent outbreak of the flu, or the need for measles inoculation in children. Information on recent food handling regulations or Food and Drug Administration policies will also be presented. The advertisements in the newspaper cover BandAids® to Radial Keratatomy®, and the health career opportunities can be found in the Want Ads section.

Materials needed:

(a) Recent newspapers preferably one for each member of the class.
(b) Begin with an empty Bulletin Board divided into two halves entitled "Health Issues In the Headlines." On one half write, "Salmonella Sam's Silly Selections," and on the other side, "Perry Paramecium's Perfect Picks."

Procedure:

Tell the class a story about Salmonella Sam and his habit of making poor health choices. He doesn't wash his hands before eating, and leaves pizza sitting on the table overnight then eats it for breakfast. Sam eats too much candy and has poor dental hygiene. He will represent the possible health choices that are unwise. Now Perry Paramecium cooks his food to the proper temperature to kill illness causing bacteria. He avoids people who are sneezing, and his dog is currently on puppy shots. Perry will represent the good health choices that students can make.

EXPLORATION

After telling the Sam and Perry story instruct the class to search their newspapers for articles, editorials, careers, and advertisements that are health related. The students can either cut out the health related items or keep the entire page intact. This activity will probably take an hour of class time.

EXPRESSION

Divide the students into groups of four or five. Instruct each group to read to their group all of the articles that each individual found from the newspapers. After all items have been read, the group members must divide the items into "Perry Paramecium Perfect Picks" (wise health choices), and "Salmonella Sam Silly Selections (unwise choices.) As the groups begin separating their newspaper items the teacher will staple the items onto the "Health Issues in the Headlines," bulletin board.

APPLICATION

After all groups have sorted the health related newspaper items and they have been displayed on the bulletin board, allow each group to explain and sometimes justify their classification of those newspaper items. Conduct a classwide discussion which allows for individual expression of choices without passing judgment.

PEOPLE CAN MAKE A DIFFERENCE

The interest in the microscopic world began almost 350 years ago when Galileo used glass lenses to study small and large objects. Anton van Leeuwenhook (1632-1723) was the founder of microbiology. During modern times groups of people such as the World Health Organization have banded together to stop the spread of diseases. However, the greatest impact concerning the fight against communicable diseases will be made by well informed citizens who make wise health choices.

J. BIG HEROES IN A SMALL WORLD

Students should be able to identify important contributions that scientists have made in history. Develop an awareness of some of the more important historical figures in the fields of health and microbiology by having students make posters portraying scientists and their accomplishments. A few scientists who may be suggested to your students are:

Louis Pasteur
J. Lister
Martinus Beijerinck
Robert Koch
E.J. Cohn
Theodor Schwann
H.L.F. van Helmholtz
W.D. Miller
Alexander Fleming.

K. CAREER SCAVENGER HUNT

Let your fingers do the walking to locate employers of health related professionals. A few examples of careers in health include hospitals, medical personnel, county health department, fire department, health clubs, genetic engineering research, volunteer organizations such as the Red Cross®, and food processing plants.

Materials:

(a) Four sets of local phone books.
(b) Paper and pencil
(c) Timer

Procedure:

Divide the class into four teams and give each team a set of local phone books. Tell them that the four teams are going to have a scavenger hunt through the phone book. They are to look for any career possibilities that are related to health. Each health career and the page that it was found on must be recorded by one of the team members. The teams will be timed during this activity. The team with the most health career choices will be given five extra minutes of healthy playtime during recess. Compile a list of health career possibilities which were identified by the four teams.

L. MY RULES FOR HEALTH LIVING

Procedure:

Review all of the information that has been presented concerning health and communicable diseases. Ask the students to create a list of things that they have learned that are good health choices. The students should take the list home, and discuss with other members of the family what items on the list might be good choices for the entire family to begin to practice.

SUGGESTED ADDITIONAL READINGS

Ackerson P., Beaman, M., Barrows, L. et. al. (1985). Gateways to science. New York, NY: Mcgraw-Hill, Inc.

Christensen, E.F. (1983). Scott, foresman life science. Glenview, IL: Scott, Foreman and Company.

Dawson, J.R., Drexler, E., Haddow, P.K. (1986). Immunology and human health. Colorado Springs, CO: Foundation for Blood Research.

Editors. (1982). Health activities project: consumer health decisions module. Norhtbrook, IL: Hubbard Publishers.

Goodwin, R.D. ed. (1991). Biotechnology at work. Washington, D.C.: Industrial Biotechnology Association.

McDowell, J., Day, D. (1988). Why wait? what you need to know about the teen sexuality crisis. San Bernardino, CA: Here's Life Publishers, Inc.

McFadden, C., Yager, R.E.(1993). Science plus: technology and society. Austin, TX: Holt, Rinehart, and Winston.

HIDE AND GO SEEK

(Grades 4-8)

By Gerald Dameon, Douglas A. Freeman & Lynn Piwowarcyzk

INTRODUCTION

The intent of the following activity is to integrate a variety of skills into one event. Most teachers agree that students tend to isolate facts. A major strength of the STS approach to education is the emphasis on interdisciplinary instruction. This activity touches on that theme, but by no means carries it to the fullest extent possible. The potential tasks that fit this activity are endless and can be easily changed to suit the particular area of study one is involved in. In addition one may alter the parameters used to locate each station. Let the boundaries be your imagination.

Objectives:

Students will . . .

1. Demonstrate use of a compass
2. Demonstrate degrees as used in navigation
3. Estimate distance
4. Use sequential steps to solve a problem

Materials:

(a) Compass
(b) Meter stick
(c) Paper pad
(d) Pencil
(e) One parent volunteer
(f) One watch with second hand

Procedure:

In advance of this activity the teacher prepares ten or twelve stations. These stations are scattered throughout the school grounds. Each station has a sealed envelope for every group. Students, in cooperative learning groups, solve the problems described on the paper within the envelope and hand this to the parent volunteer. They then take out the second paper containing the directions to locate the subsequent station. They continue on, using their compass and directions.

To guard against students accidentally or otherwise locating a station, dummy stations are established. These dummy stations have envelopes and activities just as the other stations. Students are not given credit for activities completed at dummy stations. Another means of guarding against accidental encounters is to use different stations for different groups. The teacher sets up twelve stations. Each group goes to eight stations but not all groups go to all the stations.

For example, group one would go to the following stations in this order 4, 9, 2, 5, 11, 6, 1, 3.

Group two would go to the following stations in this order 1, 12, 10, 3, 6, 5, 11, 7.

A time limit may be imposed. This time limit could be set for the entire activity or for each station.

ACTIVITIES

The following is a list of possible activities to be used in this lesson. Objectives, materials, and a brief description of the activities are written. At the end of this article, master copies of student work sheets for use at each station are provided. Make copies of the student work sheets for use at each station. Many more activities may be incorporated depending on the area of study and the grade level of the students.

STATION ONE
TRASH MASTER

Objectives:

Students will . . .

1. Accurately calculate volume
2. Become proficient in the use of the metric system
3. Calculate average weight over a period of time
4. Demonstrate ability to compute multi step problems

Materials:

(a) School dumpster
(b) Pencil
(c) Pad of paper
(d) Calculator (optional)
(e) Meter stick

Procedure:

This station is located by the school dumpster. This activity relates mathematics to science. The students utilize calculated information to answer further questions - i.e. - after determining the volume of the container students will use this answer to calculate the average weight of the trash. They will find the average weight over a given time period.

Explanation:

These problems utilize the metric system to help students better understand the system.

SIDE TRIPS AND DETOURS

In extended activities the teacher may use this activity as a lead-in to the amount of waste we deposit on a daily basis. Recycling may be explored as an alternative to land fills. If recycling bins are established, a comparison of the volume and weight may be done on a before and after basis. Research on recyclable waste could also be done.

STATION TWO
TIMED JUST RIGHT

Objectives:

Students will . . .

1. Demonstrate map reading skills
2. Determine the time differences across the country

Materials:

(a) Map of the United States with time zones
(b) Pencil
(c) Pad of paper

Explanation:

This activity requires a combination of mathematics and social studies skills. Science can be brought in as extended activities are introduced.

SIDE TRIPS AND DETOURS

Time zones can be very confusing to young students. They find it hard to visualize the sun affecting the time of day within our nation. Demonstrations of the earth's rotation on its axis help clarify this concept and introduce it in a broader context of how science affects our daily lives.

STATION THREE
TECH-KNOWLEDGE-EEE

Objectives:

Students will . . .

1. Use the word processor appropriately
2. Use the computer
3. Write one paragraph using correct grammar, punctuation, and complete thought

Materials:

(a) Computer
(b) Floppy Disk
(c) Word Processing program

Explanation:

At the very heart of STS lie the relationships of science, technology, and society. A clear definition of these three often eludes students. This is especially true if they have had little instruction from a teacher using the STS approach. In this activity the students begin to think about the difference of these areas and how they relate to each other.

The computer itself is a perfect example of how science has created the technology. The impact of computers on our society has been dramatic and the computer will continue to change our lives more and more in the future.

SIDE TRIPS AND DETOURS

As a discussion of the relationship of science, technology and society unfolds, students become aware of the positive and negative impacts of technology. The computer is a good example of this. We now are able to work faster, more accurately, and store vast amounts of information, but how have computers influenced our privacy?

STATION FOUR
RED LIGHT-BLUE LIGHT

Objectives:

Students will . . .

1. Demonstrate their ability to test for acids and bases
2. Verify their ability to use a chart for determining a finding

Materials:

(a) Vinegar (or any safe acid)
(b) Lime water
(c) Litmus paper
(d) PH chart (teacher made) for determining results of test

Explanation:

As technology advances so do the problems associated with it. The use of chemicals is one example of this dilemma. The total effect of chemicals on our atmosphere, vegetation, water, and even our body has yet to be determined.

SIDE TRIPS AND DETOURS

As educators, one of our greatest responsibilities is to inform both students and parents of the ever present danger chemicals pose daily. This awareness begins by introducing students to the basic differences in chemicals. An activity may be implemented to compare the good and bad effects of chemicals. Further investigation of proper disposal of household chemicals would be advantageous.

STATION FIVE
NAME THAT WING

Objectives:

Students will . . .

1. Demonstrate a knowledge of aerodynamics
2. Use knowledge of aerodynamics to create a paper plane that will glide
3. Demonstrate a knowledge of the history of flight

Materials:

(a) One 8 1/2" X 11" sheet of paper
(b) One encyclopedia

Explanation:

Since the first man-carrying powered flight on December 17, 1903, the airplane has been a dynamic force in the world. In a short period of eighty-nine years, we have gone from a 12 second flight of 120 feet to manned flights to the moon and back. The development of our technology of flight has been so rapid that it is astonishing.

Exploring the relationship of science, technology, and society in flight is a great way of teaching this discipline. The study of flight is very interesting, especially to children. The activities available to teach flight with an STS theme are numerous.

SIDE TRIPS AND DETOURS

The follow-up activities on flight should include more than just the positive effects on our society. Flight has created many problems for man. Some of the problems that one might want to discuss with their students would be: noise pollution, safety, ozone depletion, etc.

STATION SIX
WE THANK YOU FOR YOUR SUPPORT

Objectives:

Students will . . .

1. Strengthen a given object
2. Create a sound structure
3. Create a structure with a minimum of materials

Materials:

(a) Five - 8 1/2" X 11" sheets of paper
(b) One scissors
(c) One 500 gram weight
(d) 3 feet of masking tape

Explanation:

Although earliest man was in need of shelter, our knowledge of construction has evolved at a steady pace. From grass huts to modern skyscrapers we are constantly seeking improvement. Monuments such as the Eiffel Tower, the pyramids, and The Empire State Building serve as a reminder of our ability to incorporate beauty and strength.

The location at which one is building dictates the manner of construction. A building in Northern Russia would require different strategies than one in San Francisco, California. Each site has its unique problem, and requires its own style of engineering.

SIDE TRIPS AND DETOURS

Some students will have a basic knowledge of how to strengthen objects using support systems. Explore some of the techniques of creating sound structures. Talk of how these techniques will differ depending on climate, weather, earthquakes, etc.

STATION SEVEN
YOU MAKE ME BREATHLESS

Objective:

Students will investigate the relationship between exercise and the need for oxygen.

Materials:

(a) Watch with a second hand
(b) Jump rope
(c) Pad of paper
(d) Pencil

Explanation:

Modern technology has created more than just extra free time. We are now living in a fast paced society where it is convenient to grab a quick meal at a fast food restaurant. We spend too much free time in front of the television and not enough in healthy exercise.

SIDE TRIPS AND DETOURS

The youth of America face a life style of poor diet, little exercise, insufficient sleep, and, in many cases, a substance abuse problem. Inadequate education on many health dangers has become a serious problem for our youth. With justification, teachers complain that there isn't enough time to teach about all of the health problems faced by our society. However, we believe there is a way. If health decisions are incorporated into the curriculum, students can receive and use this vital information in a meaningful way.

STATION EIGHT
THE GRASS IS ALWAYS GREENER ON THE OTHER SIDE

Objectives:

Students will understand . . .

1. The value and the importance of sunlight to our plants
2. The value and the importance of water to vegetation
3. That disease can effect plants just as animals

Materials:

(a) Meter stick
(b) Pad of paper
(c) Pencil

Explanation:

Our survival on planet Earth depends to a large extent on our ability to cultivate the land. Whether we are farmers, gardeners, or solely consumers, we need to know how vegetation grows and how to keep it healthy. Our technology may be seriously impeding plant life of all types. We need the ability to grow edible and nonedible plants. Each are of equal value to our survival.

Many plants are far more than aesthetically pleasing, they are fundamental to the food chain. Plants offer our sole source of 0xygen,and are essential to the climate of this planet.

We, as educators, must accept the responsibility of teaching our youth the need to care for all types of vegetation. To do this we need to create a curriculum that instructs students on the proper care of plants. Native plants should be given priority.

SIDE TRIPS AND DETOURS

Plant a garden of flowers, vegetables, etc. Run controlled experiments using light, water, and nutrition as variables.

(**NOTE TO THE TEACHER**: The following pages contain student instruction sheets. Please keep in mind that these are only suggested ideas and that you may replace any or all these ideas to supplement your curriculum.)

TRASH MASTER

Welcome to the "Trash Master". You will find three problems to compute. Please think through each question and, above all, be accurate. GOOD LUCK!

1. Calculate the volume of the trash dumpster using your meter stick. Remember to label your answer.

   ____

2. One cubic meter of trash weighs an average of 2,000 grams. Find the net weight of a full dumpster. Express your answer in kilograms.

   ____

3. Calculate the weight of trash collected during four full weeks of school.

   ____

After completing your answers give this sheet to your parent volunteer. Take the second sheet of paper with the location of your next station and proceed.

TIMED JUST RIGHT

Imagine that you have been assigned a project dealing with animals of the ice age. While researching this topic you read an article on the breeding habits of sloths that refers you to the New York Museum of Natural History. The school will allow you to make a 3 minute phone call to request the information you need. You are in Arizona. The person you need to contact is in the museum between 11:00 am and 12:00 noon Monday through Friday. What is the latest time you can place your call to the museum on any given day?

____

Give this sheet containing your answer to your parent volunteer and follow the directions to your next station.

TECH-KNOWLEDGE-EEE

I knew you would make it.

Please be seated at a computer. Access the word processor and follow these directions:

Write one paragraph describing how one of the following technological topics affects your life. Grammar, punctuation, and content will be scored. Please be specific.

TOPICS

- Modern telephone systems
- Nintendo Games
- Smart Bombs etc. in the Persian Gulf War
- School records on computers

When finished please save the information on your floppy disk and give it to your parent volunteer. Take the second sheet of paper and follow the directions to the next station.

RED LIGHT - BLUE LIGHT

Welcome to station four of your long journey. You will find bottles containing liquid and the necessary pieces of litmus paper. Determine which is an acid and which is a base. After putting the paper in the liquid, compare it with the chart. Record your answers below and then give this paper to your parent volunteer.

Bottle "A" ______________________________

Bottle "B" ______________________________

Remove the second paper from the envelope and proceed to the next station.

NAME THAT WING

Congratulations! You have just arrived at station five. It looks like you are doing just fine. Now this will be a fun activity for you.

Use the provided sheet of paper to construct a paper airplane. Throw your airplane and measure the distance it travels. It must fly a minimum of three meters.

Draw a picture of the airplane in the space provided below.

Name your plane after the inventors of the first airplane. Write its name on the right wing. Give the plane to your volunteer. Take the second sheet of paper with directions to the next station and continue.

WE THANK YOU FOR YOUR SUPPORT

Using only the five pieces of yellow paper, scissors, and tape provided, build a self supporting structure. It must support the 500 gram weight. You may use the tape and scissors as you wish. Be sure your parent volunteer verifies your structure's ability to support the weight.

Draw a picture of your structure in the space provided below.

After you have finished take out the second sheet of paper and continue on to the next station.

YOU MAKE ME BREATHLESS

Quickly divide your group into:

1. Time Keeper - one who uses the watch to keep time,
2. Recorder - one who writes down information, and
3. Jumper - one who does the exercise.

The time keeper counts the number of the jumper's respirations for fifteen seconds. The recorder must write this data down. The time keeper will keep time for one minute while the jumper jumps rope. At the end of one minute the observer checks the respiration again for fifteen seconds. This data is also recorded.

1. What was the respiration at rest (before jumping)?

   ____

2. What was the respiration at the end of one minute of jumping rope?

   ____

3. Explain the difference in respiration, before and after.

   ____

   ____

   ____

   ____

   ____

Give this sheet of paper to your volunteer and take out the second sheet of paper. Continue on to your next station.

THE GRASS IS ALWAYS GREENER ON THE OTHER SIDE

Welcome to station eight. Remember your past experiences and what you have learned in class. Don't worry. You will do just fine.

Locate the yellow patch of grass with a diameter of about 4 decimeters. Based on the information obtained in class give two possible reasons for the discoloration of the grass and at least one remedy.

____

____

____

____

____

____

Now take out the second sheet of paper and locate the next station.

HISTORICAL ARTIFACTS: STS INSTRUCTION THROUGH THE STUDY AND DEFINITION OF ARTIFACTS

(Grades 6-7)

By Teresa Olson

A few years ago, when I was teaching in Williston, North Dakota, the town was celebrating its Centennial. As any resident of a rural area can tell you, one of the greatest advantages of living in a small town is the depth of involvement of the community in city sponsored events. As the time for the celebration grew near, everyone found themselves caught up in a whirl of activity, with specific duties to perform. In a situation like this, it is difficult to avoid making a contribution to the overall learning, entertainment, and community pride building schema that engulfs everyone who lives in the area. Sewing circles design costumes and quilts, auto clubs organize a historical review of vehicles for the parade, music groups research music of different periods. Community clubs vigorously hunt up artifacts for display in the forms of furniture, architecture, photography, jewelry, clothing, tools and utensils, art, newspapers, and literature. Naturally, the schools were expected to make their contribution as well.

Each school in the town had some form of historical exploration activity designed to involve the students in the celebration, but my school, Webster Elementary, was the focus of some special events. Built in 1907, Webster was the oldest continuously functioning school building in the town. Walking up the stairs to my Sixth Grade classroom each day was a bit like taking a walk through time. We enjoyed original black slate chalkboards covering about half of the walls, and old fashioned high ceilings. Many of our current students were second, third, or even fourth generation products of area school families. Naturally, with such a history, we wanted to host a reception with special displays in each classroom.

These displays and projects included literature studies, dioramas, posters, models, musical numbers, and research. Our 5th Grade teacher discovered that there was no written history of our school. She therefore concentrated on discovering the original history of our school building. She went into the microfilm records of old newspaper editions and pieced together a history which she used for both reading lessons, and display in her classroom. Her students placed an advertisement in the town paper requesting former Webster alumni to come forward with old photos, examples of books or homework, old report cards, or any other mementos they might have to offer. Her students interviewed Webster alumni, and wrote about their experiences.

I had felt a bit overwhelmed with the project, and in desperation, fell back on an old trick of pushing nearly the entire work load off on my students. I brought in laminated photographs of items from an in-state historical museum. These items were technological products from the early nineteenth century. I had laminated these photos with identifying numbers. They had no additional labels to help the students determine what the artifacts were.

On the first day, I passed the photos out with the instruction that we would be playing a game to try to identify the artifacts in the photographs. After a few tries, the students complained that they didn't have enough information available to make a guess, and asked me to just read the list of the answers. When I announced that there was no answer key, and that I wanted them as a class to research the history of the objects as their next social studies project, there was some complaining. I reminded them that I had not said they had to identify the artifacts that day, or by themselves.

Actually, I was using an unusually sneaky method of introducing their next social studies project. We would take field trips to the public library and a local historical museum, where they could locate resources to help with the identification of these objects. Now, as the children were showing some interest in the assignment, I reviewed the requirements. They were to find out these things about each object in question:

Object's name, inventor, purpose, cost, construction, effect on society, popularity, approximate year of invention, and present-day market form (if available).

The students were told that their grade would be determined by the number of items they identified, how many of the required object descriptors they incorporated in their identification, and the quality of their special area written report. In the special area written report, the students were to pick some element of the period of history from the 1900's to the 1930's, explore, and describe it. They were responsible for bringing in a minimum of two outside sources into the classroom for display on the day of the reception. Their finished projects and descriptive identifications of the artifacts would also be on display that day. Now the students were ready to begin the process.

Students began to identify their special areas of research the day of the field trip to the library. These included historical and political themes as well as artifact themes such as "The First Automobiles". As the students became more and more involved with their research, we found ourselves in the midst of impromptu historical lessons about a variety of topics. Prohibition, the changing value of currency, the birth of equal rights for children, women, and minorities in the U.S., girdles and other restrictive women's undergarments, refrigeration, methods of warfare, and various historical, political, ethical, and moral issues were discovered.

One of my students found an old reproduction of an advertisement for a "Wife Beating Machine" that at one time was legal to manufacture, advertise, sell, and more horrifically, use. This lead to a lesson on the evolution of human rights in the U.S.A. that had a high degree of student involvement.

As the students continued to develop their projects, I became less of an instructor and more of a learning facilitator. Student involvement in their own choice areas became so intense, that there were days the children would resent any interference with their work time. Rather than trying to involve the entire group in a lecture format, I found it easier to just shout out something like, "Hey, we're having a discussion about the weapons involved in World War I. Anyone that's interested, come on over." The students who were interested would come over, and the rest would continue working on their own choice area. Students became involved with their own topic choices, and developed wonderful projects and displays.

On the day of the school reception, the classroom was in prime condition for visitors. I didn't have to badger any of the students into cleaning up their areas. Actually, they had expressed some definite opinions about the state of my desk, and helped me clean up my work area. There were project displays on each desk, reference displays at several key places in the room, and wall displays of posters and diagrams. I had printed copies of the artifact definitions supplied by the students and displayed them next to the photograph of the described artifact. The students would drag visitors around the room to show off the definitions in which their names would appear as author or co-author. As some of our senior citizen visitors worked their way through the room, they told stories about their earlier lives, stories brought back to mind by a picture of an old pencil sharpener or box camera.

Not every school has a civic opportunity such as this one to explore history, but I'm sure that any classroom could have a successful artifact identification special project to explore a given period of history.

IT WAS THE BEST OF TIMES AND IT WAS THE WORST OF TIMES

(Grades 6-8)

By Vanessa Salas

INTRODUCTION

Society's mores and values can change the way people live their lives. Students need to be aware of the impact society has on their lives. Over time society has gone through many changes. In order to help students understand the changes that American society has undergone throughout the years, I have developed a "Time Era" project.

GETTING STARTED

This project was geared for sixth, seventh and eighth graders. This project may last approximately four to five weeks. Each group may consist of four to five students, allowing for six or seven cooperative learning groups in the class. First, each group must choose a specific decade to research between 1900 and 1980. Students should have access to reference books for research purposes. An excellent set of reference books to begin with are the Time Line Series (1990) by Crestwood publications.

FIRST WEEK

After each group has chosen a specific time period, they will begin to research the different inventions and scientific breakthroughs that occurred during the decade they have chosen. For example, some of the inventions include the light bulb, the color television, the chocolate chip cookie. Some examples of scientific breakthroughs are the discovery of penicillin, and x-rays. When they have researched two to three inventions and two to three scientific breakthroughs they will make their own models of these inventions and scientific breakthroughs and demonstrate them. The more creative the students are with their inventions, the better.

SECOND WEEK

When the students have finished their research on inventions they will then move on to research historical events that occurred during the same time period. These historical events can be major events such as the assassination of John F. Kennedy or the Challenger disaster. These events may also be minor events such as the first comic book or Elvis recording his first song. The students should research at least four historical events. Using these events, students will then create a wall mural using butcher paper, markers, chalk, etc. Remind the students to use their imagination and creativity to make these murals more interesting. While the students are researching their historical events they also need to research at least three famous people from the same decade. These famous people may be rock stars such as Elvis, athletes such as Babe Ruth or scientists such as Albert Einstein. Students should display each famous person with a picture or poster depicting what they looked like. The students must also write an essay about why each of these people became famous and what contributions each of these people made to our society.

THIRD WEEK

In every time period society has had different beliefs and values. Students will be able to learn by interviewing and talking to different people who experienced first hand what life was like growing up during that time. First, each student will need to write at least thirty possible interview questions. These questions should investigate what life was like. For example, "What did you do for fun?," "Where did you go after school?," "Did both your parents work?," "How many of your friends had parents that were divorced?". These questions can be about what kinds of music they listened to, what types of technology was new at that time, what schools were like, etc. After the students have written thirty or more questions they will begin to locate a person to interview. The students need to interview someone who grew up during the time period that they have been studying. It is easier and often more interesting for students to interview teachers at their own school. The students and teachers will set up times for the interviews. After they have completed their interviews, students will use their questions and answers to write a paper about life in the 1900's, or 1920's, or whatever decade they chose to research.

When each student has finished the interview paper, he or she will go on to research the different types of automobiles that were made during each time period. The students can draw pictures of the different types of automobiles on tag board illustrating the different models that were produced each decade.

FOURTH WEEK

At this point in the project the students will be able to engage in some type of activity that will get them moving and will also help renew their motivation. The students will research and learn two different types of dances using appropriate music that was popular in each reported time period. Good reference sources would be your school's music teacher or your local public library. Students will be able to acquire plenty of information about the types of dances and music that was popular during different decades. With limited class time the students may need a couple of weeks to learn and practice their dances. They should practice their dances using music from that specific decade. While the students are learning their dances their groups must also continue researching the type of clothing that was worn during that particular time period. The students should bring in clothes from each time period, such as poodle skirts, hip huggers, leather jackets, or whatever else was being worn at that point in time. Students of each group should also model these clothes to the rest of the class.

CONCLUSION

In order to bring this project to closure, the students needed a way to show off everything that they had learned. The students came up with the idea of a "Time Era Party". Each group decorated a corner of the classroom to look like the roaring twenties, the nifty fifties, or whichever decade they were studying. Groups brought in favorite foods from each time period, set up inventions, hung up murals, posted interviews and displayed their essays. They also dressed up like the people from the twenties, thirties, forties, etc. We set aside an entire afternoon to perform dances, share food and preview the different displays. This was a long, but very interesting project. The students were able to work in cooperative learning groups. They used problem solving, decision making and social skills. The students also identified scientific milestones, and gave examples of how science and technology have changed over time.

At the end of this unit students were able to do the following:

- Identify major turning points of the 20th Century.
- Identify the cause and effect relationships of major events during specific time periods.
- Explain the development of technology from 1900 to the present.

The students had a good time and learned a great deal about the many changes our society has undergone through the years between the 1900's and the 1980's.

LANGUAGE ARTS AND STS

·(Grades 6-7)

By Teresa Olson

INTRODUCTION

The curriculum wars in the United States have escalated in the last 10 years. Everyone involved has his or her own private agenda of important themes they deem essential for adequate instruction. The net result is yet to be determined, but one certain result of all of the controversy is sadly overloaded curriculum plans with precious little time allowed for students to develop their own interest areas. Along with the problems of an overburdened curriculum are ideological issues within content areas that are difficult to reckon with, given the current methodology of standardized testing within the United States. I do not presume to believe that I know all of the answers as to which form of reading instruction is superior, but I'd like to share a coping strategy I've developed to deal with reading skills instruction within the context of high-interest and legitimate text.

As a teacher of a self-contained sixth-grade classroom, I am completely familiar with the overwhelming sensation of having too much curriculum to cover, and far too little time to do justice to any of it. When I became interested in STS instruction, I wondered how I was going to fit anything else in my already overcrowded curriculum. I'm still struggling with this issue, but I have discovered a way to integrate language arts instruction with STS themes, and I'd like to share it with you.

The idea is very simple. I have subscriptions to newspapers and periodicals purchased for my classroom, rather than new textbooks. When I see an article that is a high-interest STS theme, I simply design learning tasks to accompany it that meet a language skill goal targeted for my age group.

This approach has both strengths and weaknesses. Perhaps its greatest weakness is that you can't often save materials you create from year to year, as you are usually using items from current periodicals as your lesson base. To put it more plainly, it's a lot more work than simply walking your class through a reading basal series. Also, you're not going to be able to walk into a teaching store and find a set of duplicating masters for this purpose. You are on your own.

The advantages of this system, however, far outweigh the disadvantages. It allows a stronger match with some of the most important factors affecting the development of the reading process. Most reading instructors believe that reading is an interactive process with the reader incorporating chunks of meaning from the text into a network of knowledge already in place. The success of this process is dependent on many factors. These factors include, among other things, depth and strength of personal background information of the reader, attitude of the reader to the text (interest level), strength of the reader's strategies for interpreting text, and clarity of the author's message.Using current mass media sources for reading lessons will generally have a high interest level for the students, and will always have more current and meaningful information than anything available in classroom textbooks.

Anyone familiar with the appalling statistics involving adult use of printed materials in the United States must realize that we have traditionally had a problem relating a relevant personal need for reading in students' daily lives. To put it more plainly, many Americans' daily reading experience rarely goes past occupational needs, menu choices, and the TV schedule. A child who does not read a daily newspaper is more likely to become an adult who does not read a newspaper. There is a commendable movement in both elementary and secondary schools to include a greater degree of real literature in students' education, but I believe we need to go one step further. We need to provide meaningful experiences for students with newspapers and magazines.

USING PERIODICALS IN THE CLASSROOM

WARNING! Most major publishers and authors take the copyright law very seriously! Many teachers, chronically hampered by insufficient budgets to serve their students' needs, have indulged in much more creative interpretations of the law than is prudent. You need to be aware that there are new companies engaged in the planting of undercover moles hired to dig up copyright infringements in our schools. They may appear as a school aide, a visiting parent, or a substitute teacher. These people make multi-thousand dollar commissions on copyright infringement lawsuits. The lawsuits are successful, and business is booming. For this reason, I'm going to specify many legal avenues of text procurement.

Most major newspapers have a educational newspaper program. They offer newspapers at a significantly lower than newsstand price, usually about a 50% reduction. They will often inservice staff at no cost other than the price paid for the papers. Many of them also have a teacher's guide with marvelous suggested activities. There are national periodical programs as well. There are many publications that feature a no-cost product sponsored completely by the advertisers. In the Phoenix area, we have a free avant-garde entertainment and news weekly that frequently features articles about STS themes. With some of these publications, beware that some of their advertising and personal ads, while notoriously educational, may not be suitable for classroom use. Even shopper's guides or brochures featuring rental properties available in your city, such as those passed out at local supermarkets, may prove to be useful.

I have designed story problems around sale brochures and take out menus which were provided at no cost. My sixth grade students enjoyed the lesson based around the map and program featured at a major metropolitan zoo, and may consider visiting there if they ever reach that city. It's true I had to go through the checkout line at the gift shop quite a few times to supply both 6th grade classrooms with pamphlets, but most teachers aren't unfamiliar with such behavior. Travel agents can supply fabulous pamphlets, but will not want to give you 33 copies at once. You could write the company who produced the pamphlet, asking for copies, or for permission to reproduce them. Check with car dealerships about brochures describing their vehicles. Items produced by the U.S. government, such as informative pamphlets, are often public domain documents, and may be reproduced. You may also request 33 copies of them, and even avoid the cost of reproduction.

Magazines are a little more tricky to use well. Current copyright laws prohibit the reproduction of materials without permission, so the practice of photocopying articles for a class from a magazine could lead to significant legal difficulties. There are ways to receive permission from some magazines for limited use of the article, however. Some magazines have an education program with a reduced price on a bulk order. Whenever such a program exists, you will not be able to receive copyright permission to copy the article. Other magazines, who do not have a specific program for educational involvement, are slightly more approachable. You may receive permission, via fax or mail, to copy articles for limited classroom use, providing that the magazine owns the copyright. If they don't, they will have to refer you to the author, or owner of the rights. Check the table of contents page for information regarding contacting the magazine's publishing offices. It may be easier to choose one general magazine that suits your students' reading level and order one copy per 2 students, to use on a regular basis. Articles from these sources may also function well as a kick-off to pure content studies in science or social studies, as students will often be more open to a learning task when they have a perceived need to learn, a need which may develop when they read about a topic they are interested in, but don't fully comprehend. We also use the weekly classroom magazines such as Weekly Reader® and Jr. Scholastic®, but their content is a little too carefully controlled for readability to be sufficient in themselves.

INTRODUCING YOUR STUDENTS TO PERIODICALS

I'll never forget the first day my students had USA Today® delivered to our classroom. I assumed that I would be able to give them an activity requiring them to search through the paper to find various pieces of information from various sections of the paper. I'll be perfectly honest, and tell you that the only lesson learned that period, was that I'd designed an exceptionally weak lesson. My students taught me that I needed to give an introductory lesson about how to use a newspaper.

Watch your students to judge their level of familiarity with the periodical you choose. Some students may not know how to hold or fold a newspaper. Most of them may not realize that the periodical is split into sections. You will need to familiarize them with the organizational plan of whatever periodical you use, and have them practice using it before you do anything else. With the younger, weaker, or less confident readers, you may need to review strategies for skimming or hunting for information.

VOCABULARY ACQUISITION STRATEGIES

One of my favorite reading activities with periodicals deals with a vocabulary acquisition strategy session. Pick a high-interest article of suitable readability that contains some vocabulary words that will be a challenge to your students. Supply your students with highlighting pens. Explain that you will be reading the article aloud, and there will be a discussion time when you are finished. Ask your students to highlight any words that they do not know the meaning of. Promise them that there will be no use of dictionaries to follow, or they will not mark any as unknown. At the end of the oral reading, allow some time to discuss the article, so that you can be sure its main message is clear to your students. Now ask your students to volunteer some of the words whose meanings were unclear to them. Stress positive, non judgmental reactions to the word choices of fellow students, or your classroom will probably become rife with put-downs, and students will no longer volunteer.

Use a few examples to show strategy, such as examining content before and after the mystery word and word replacement to attempt to bring meaning. Do not allow dictionaries to be used during this lesson. Explain that you are interested in teaching them ways to add new words to their vocabularies, as they are reading, by using the text itself. Once students get used to this in-context vocabulary acquisition strategy, their working vocabulary will grow rapidly. After the students have seen you practice this system using a few words, ask them to volunteer approximately 10 words. List these words on the board, and give them directions to work with partners, using only the article itself, to try to guess the meaning of the chosen words.

You may wish to choose partners for the students, as your more able readers should be teamed with less able readers to provide positive models and alleviate frustration. Explain that it's a game, and as long as they do their best, they will receive, at a minimum, a passing grade. Give a time limit, and ask them to appoint a reporter, a recorder, and a timekeeper. At the end of the allotted time, have each of the groups report their guesses of definitions in a round-robin style, focusing on one word at a time. After each reporter has reported, give one point for each correct answer, and an additional point if there is a 'best' answer. Don't give points for a correct meaning of a word if it is used in a context different than the one used in the text. Have a student keep track of points on the chalkboard. Have the recorder turn in each group's paper, with the names of all the students in the group, for recording their grades. You will need to repeat this activity often if you want your students to internalize vocabulary acquisition from printed text. Repetition of the lesson and a variety of examples of words and text will teach these strategies better than any other method I've discovered.

ESSAY QUESTIONS

Pick an article of high-interest and rather low readability content to teach this lesson. Write 4-5 essay questions about it, and introduce your lesson by showing examples of adequate, inadequate, and overly wordy essay answers to the first question. Students benefit from example in this area. Don't assume that they know what a good essay question looks like. They may not. Allow them time to work with partners to compose answers, and use the reporting technique mentioned in Vocabulary Acquisition to give them feedback as to adequacy of response. As independent study, assign them another short piece of reading with 2-3 essay questions to answer .

During the following class period, ask the students to get together in groups, and read their answers to each other. From all of the answers, they should compose one complete answer. Use the same reporting method, and give adequate description of why answers are correct or incorrect.

For the next independent practice of essay questions, assign an independent piece with 4-5 questions, with the stipulation that the homework will come to you first. You will then give each answer that each person provides from 1-5 points, based on the adequacy of response. Explain that you will then hand the papers back for them to use in the group sessions where they will compose the best possible group answers. Group success will therefore be highly dependent on individual effort. Repeat this lesson numerous times, and you can cover a variety of contents while instilling this valuable skill.

SUMMARIZING

Newspaper interviews of sports or entertainment stars work well for this activity. The first time you do this, as with any of these skills, start with an oral reading of the article followed by a discussion period.

Next explain that you want them to pretend that they are re-telling the article to someone outside of the classroom like a friend, a sister or brother, a parent, or anyone else. They need to do a good job of telling all the important parts, but they don't have time to tell everything. There needs to be things included from the beginning, middle, and end. Ask them to plan in their minds what they are going to say, and then write it out. It should be no longer that one-third the length of the original article. This is to prevent students from merely copying the entire article rather than making decisions about which parts of it are more important than others. They will need at least 20 minutes to complete this work.

When the finished papers come in, evaluate them to find the top 4-5 papers in terms of following the assignment directives, rather than mechanics of spelling, handwriting, grammar, etc. Type them up, without including the name of the students who wrote them, and pass them out to the students. Announce that you picked the top 'A' papers and printed them up. Ask them to think about which one is the best, and why they feel that way. Have them volunteer statements about any strengths they see. You may wish to have them vote on which one they feel is the strongest, and announce a winner.

MAIN IDEA

You will need a class set of highlighting markers, a class set of consumable copies of one article, and a transparency of the article made on a thermofax machine. Ask your students to mark with their highlighter the sentence from each paragraph that they think is closest to being a main idea statement. Assign 4-5 paragraphs, give 5-10 minutes to work on it, and correct. Then repeat this sequence 3-4 more times. As the students come to realize that there is no answer key, they will begin to contest your statements, and make you defend your choices for main idea. It may even be wise to occasionally allow them to catch you making an error, so that they are really watching you. This would only mean they are paying attention to the task at hand.

SEQUENCE

This is a very simple activity to teach. You can prepare a list ahead of time or have your students identify the most important events in the article and write them on the chalkboard in a random, non-chronological order. The students rewrite them, in chronological order. Some periodical articles do not have a strong time sequence component, so choose judiciously.

PARTS OF SPEECH

You can ask students to highlight all examples of one type of a part of speech in a paragraph (noun, verb, etc.), and then compare these with a key list. There will be pretty tough arguments about some of the student's answers, because these articles will have a less controlled language than a grammar worksheet, but that will just improve students' attention to the task.

IN CONCLUSION

I also use periodicals to teach outlining, author's purpose, word referents, and many other skills. I prefer to begin, especially during early sessions, with an oral reading of the article in question. This will be accomplished by either myself, or student volunteers. I've described several strategies, but remember to start with simpler ones, and allow them to work together for the product at first. The idea is to help them feel comfortable with the text, and they may find it slightly threatening, at first. Limit the amount of skills paperwork per article, so you don't lose the focus of the author's message. Also, there is a danger of adding so much work to the experience, that you will take all the enjoyment out of it. Remember, you want to leave your students with a positive feeling for whatever media you are using, so that they may search out a similar use on their own.

THE LEARNING SPIRAL: TRY IT, YOU'LL LIKE IT

(Grades 5-8)

By cahal o'coileain

INTRODUCTION

I was first introduced to the learning spiral concept as a lead teacher in the STS project at Arizona State University. Eight teachers, two from each of four inner-city schools in the Phoenix area took part in the project. The following is a brief description of the lesson, "melting ice," that was presented to initiate our group of teachers to the *learning spiral.*

We were divided into teams of two were told that each team would be doing a problem solving activity that involved devising a way to best melt an ice cube. Each team was given the following materials:

(a) one baggie containing one ice cube
(b) one small graduated cylinder
(c) calibrated in milliliters.

The instructor gave the following verbal instructions:

> "The object of this activity is to see which team can melt the most ice in a given period of time. You will each have ten minutes from the time I tell you to start. You may use only two of the ten minutes to do the actual melting. You may not touch the ice directly. You may not remove the ice from the baggie. When your two minutes are up, pour the water from the baggie into the graduated cylinder See how many milliliters of water you have melted. Spend the rest of the time left to discuss your results with your teammate, jotting down some notes, explaining why you chose your procedure, and what science principles were involved I suggest you start by spending a few minutes planning your strategy.
> Are there any questions?
> GO!"

Afterwards, we learned that during the introduction, the teacher tries not to give out too much information. The idea here is to allow students to be as free as possible to creatively explore and develop their own ideas. Putting students in teams allows them to learn socialization and leadership skills. Setting up a competitive situation between teams presents them with an interesting challenge!

EXPLORATION

Each team spent the initial three or four minutes figuring out the most efficient way to proceed. Two teams decided to hold the baggie in their hands, warming the ice to cause it to melt. Another team crushed the ice by hitting the baggie with a heavy object. This was a good idea, but their baggie tore, spilling the ice onto the table. The last team twisted their baggie to remove all the air and inserted it into a cup of hot coffee that one of them had at their table.

On the first team, one person warmed the ice in his hands and measured three mm. of water. The second team, passing the baggie back and forth between them, alternately rubbing their hands together to warm them, measured five mm. of water. Team three was disqualified, since their ice was "out of the bag!" Team four measured twelve mm. of water. Each team then spent the balance of their remaining time preparing to answer "how and what" questions during the discussion that was to follow.

Later, we learned that during a second phase of the lesson called "exploration," the teacher monitors students' progress, asking a few questions to provoke thought and to remind them to watch the time left. We were also saw the importance of using hands on manipulatives when designing lessons.

EXPRESSION

The instructor asked team one to tell us what happened and why. They said that they had decided to use the "warmth" of their hands to melt the ice, but that obviously team four had a better game plan. Team two said that they had the same idea as team one, but had improved on that plan by passing the ice back and forth, rubbing their hands together to get them warmer. Team three said that their game plan was to break the ice cube into smaller pieces. Smaller pieces would melt faster than one large one. Team four said that their plan was to expose the ice to the hot coffee to make it melt fast.

We later learned that in an "expression" phase the teacher wants to elicit responses from the students, praising their ideas, but being careful not to control the discussion by giving opinions. The idea here is to keep them thinking! This phase is important for two reasons. While establishing the basis for continuing discussion it enables the teacher to evaluate the validity of students' perceptions.

At this point in our lesson our instructor told us that there are five major components in a typical "learning spiral" lesson, a hands on problem solving approach that challenges students to think!

They are as follows:

INTRODUCTION
EXPLORATION
EXPRESSION
LABELING
APPLICATION

He told us that the next phase of the lesson would consist of our naming or *labeling* and defining the concepts that we had identified or discovered.

LABELING

The instructor then asked what "warmth" means. Answers included the words "heat" and "energy," which were written on the chalkboard. The teachers were then asked the meaning of these two terms. Answers varied and each was written on the board under each term. The relative merit of each of the answers was debated until consensus gave accurate definitions to the two concepts. In the process other relative words and terms such as rubbing, friction, insulation, surface area, heat transfer, conduction, convection, radiation, fluids, solids, liquids and gasses were mentioned, described and defined on the board. The learning *spiraled*! Team four now was able to say that they were so successful because heat energy in the coffee was transferred toward the ice cube by convection in a fluid They were also able to explain that the air in the baggie was an insulator and that by removing it, heat was transferred directly to the ice cube by conduction! Pretty good, huh?

The object of this lesson as devised by the instructor was to teach heat transfer by radiation, conduction and convection. In this lesson most of the words, terms and concepts defined came from the memory banks of the teacher students. Had they not, the instructor would have "helped" by suggesting terms and asking leading questions during "labeling."

Here, again, the teacher wants to keep the critical thinking process going, making good use of wait time and trying not to hurry students or to "put words in their mouths." If the lesson doesn't get done today, no matter. If the students continue to be actively involved, the teacher should allow the lesson to continue to spiral. Another, related, hands on, problem solving experience tomorrow will pull them right back in again! The spiral can continue until all objectives have been covered. Theoretically, a learning spiral can continue indefinitely, as long as it continues to move into subject areas pertinent to the curriculum.

APPLICATION

In this phase, we were asked to think of other applications of the heat energy concepts that were explored and labeled. Parking a car in the shade, building construction materials, a fireplace and refrigeration were some of the topics discussed. A lot of ideas were shared about everyday uses of heat with new understandings of the processes involved.

The teacher helps students to think about further applications of the concepts by asking key questions. Students will have new insights about topics that may have heretofore been only vaguely understood.

A SAMPLE LEARNING SPIRAL LESSON

Lessons in almost any discipline or subject area can be adapted to the learning spiral model. The key to doing so is to take the fact, idea, or concept to be learned and turn it into a question, exploration, or problem solving experience. For example, in math, most textbooks start out with a fact or definition. Then a sample problem is shown and dissected. Next, a few more problems are worked out, followed by similar problems for the students to do, using the sample problems as models. Very low level thinking is occurring here! It's no wonder that we have to "teach" the same math concepts over and over again, year after year. Let us see how a different approach might work, by looking at a learning spiral lesson on "ratios."

INTRODUCTION

Divide the class into teams. Give each team a box containing poker chips of different colors. Present students with a (ratio) word problem, but don't give them the word, "ratio." For example, the teacher might say, "Ten cars drove past a house. Two were blue and one was black. The rest were other colors. Arrange your chips to show all the cars." (Succeeding problems can be more complex.) Tell them that they will have five to ten minutes (depending on the problem) to arrange the chips into some pattern(s) that represents what the word problem is stating and asking. Tell them that they should jot down notes about what they have discovered.

EXPLORATION

Students work for designated period of time, arranging chips into patterns.

EXPRESSION

Each team explains their procedure(s). Some may have used more than one color in their pattern(s). These students will have discovered more than one way to express the problem!

LABELING

Students may come up with the basic concepts. The teacher guides them to visualize, understand, and name the concept, "ratio." Other words, such as "fraction," may be introduced by students into the discussion. These words and their related concepts should also be defined. After all of the lessons covering the subject of ratios are taught in similar fashion, the lesson might spiral into the subject of fractions. Continue to use the chips, or for variety, some other manipulative.

APPLICATION

Examples that deal with familiar everyday practical problems are presented with students finding answers. It is most important here to take the time to allow students to utilize their new found knowledge to solve "real world" problems that they can use or identify with. Information that is useful is not so easily "forgotten."

NOTES AND COMMENTS

The more ways one can devise to get students involved, the better. If it is not possible to find a hands on manipulative to use in a certain lesson, a question, issue or problem can still be presented. The teacher can direct the students to explore mentally, utilizing team discussion, maybe drawing a design, graph or picture, or writing a paragraph. In a social studies lesson, for example, if the teacher is introducing a unit on the causes of the civil war, ask each team to think, discuss, and write down three different reasons that two people might come into conflict with each other. As soon as they have done this, each student on each team could make a simple stick or line drawing showing how the conflict developed. Afterwards, students can share their ideas, expressing the causes for conflict. The teacher can guide the students in drawing inferences concerning the causes for wars, naming, labeling and defining concepts. This can be followed with research/investigation into events preceding the civil war, and application of the concepts. The teacher might allow the learning to spiral by having students test out their concepts by "application" to all the other major wars in our history. Yeah! A unit on war! Who said that history has to be boring! Who said that history has to be learned chronologically?

A lesson in language might find the students learning the use of periods and commas. Give each team a paragraph, highly enlarged on a poster board with no commas or periods used and a stack of commas and periods to put in place. Have them jot down notes as to where and why they used them. Continue the process as outlined above, expressing, labeling and applying. Let them write "trick" paragraphs of their own to try to stump each other for additional lessons. The students will learn and have fun!

The learning spiral method requires students to use higher level critical thought processes, applying concepts learned to solving new problems that ideally they initiate. Students stand more of a chance of having such concepts as using ratios or commas or any knowledge "stick," if they are so practically involved in the process. That is the intrinsic value of the learning spiral!

LIFE SCIENCE WITHOUT ANIMAL DISSECTION

(Grades 4-8)

By Rhonda Gross

INTRODUCTION

High school biology 1973-I was poised and ready to open up a fetal pig with a scalpel. I had always wanted to see the inside organs of an animal. As I looked around the lab, I thought it odd that I was the only girl in the class. All the other girls had ditched the class or had faked a note from their parents.

Years later I find that this squeamishness about dissection now includes both girls and boys. Many students have ethical concerns about the taking of an animal's life for the purpose of classroom scientific investigation, and some due to weak stomachs are distracted from learning the concepts that hands-on dissection is supposed to facilitate. In many schools enrollment in biology courses is down because of required dissection assignments.

Teachers today are faced with tough decisions concerning life science education. They wonder if students can develop an appreciation for the natural world through life science without dissection. The cost of materials for learning activities using dissection has also become prohibitive for many biology programs. Technology has provided some excellent alternatives such as computer software-based dissection simulations. There is also a growing number of resources available which offer educational activities that do not include the use of living things. Included in this article are activities, suggestions, and resources that will help fulfill course dissection objectives. However, the humane use of animals in biology will ultimately be the classroom teacher's decision.

ANIMAL CELL JIGGLERS

Objectives:

Students will . . .

1. Use animal cell jigglers to dissect, identify, and classify the organelles of animal cells.
2. Identify their animal cell jiggler as either male or female by the chromosomes it contains.
3. Evaluate the differences between real cells and animal cell jigglers.

INSTRUCTIONS FOR MAKING ANIMAL CELL JIGGLERS

Materials: (for 12 cells)

- (a) 4 large boxes of yellow (lemon flavored) gelatin
- (b) Water
- (c) 9" x 13" cake pan
- (d) Knife and spatula
- (e) Colored construction paper
- (f) Laminating machine or clear contact paper
- (g) Scissors

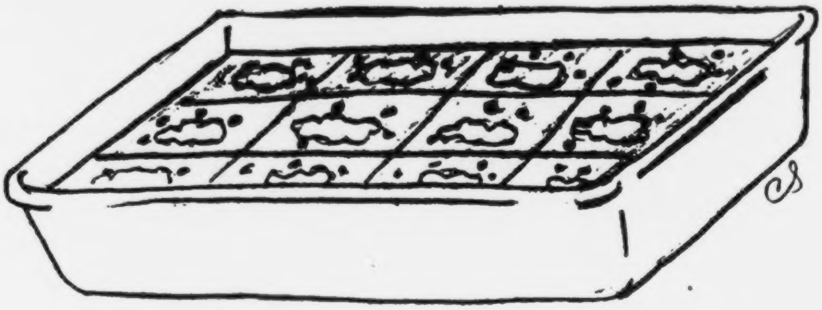
Procedure:

1. This recipe must be completed at least 3 hours before the lab.
2. Draw the following organelles (the organs inside the cell) on construction paper, and use a different color for each one. The organelles' sizes should be drawn in relationship to each other. The nucleus should be about the size of a quarter. All other organelles should be smaller than that. A life science textbook might be helpful as it will have a detailed picture of a cell and its organelles.

   mitochondria
   nucleus
   ribosome
   endoplasmic reticulum
   vacuoles
   X chromosome
   Y chromosome
   Golgi process.

   You will need at least 12 nuclei, and 20 to 30 of the other organelles.
3. Laminate each colored paper.(The organelles can be used without laminating them, but they get soggy. If they are laminated they can be used over and over again.)
4. Cut out all of your organelles.
5. Boil 2 cups of water and mix in 4 packages of yellow gelatin.
6. Pour the gelatin into a 9" x 13" cake pan.
7. In each 3" x 3" section of the cake pan you will build a cell using the organelles you have cut out. Each cell will have 1 nucleus, 1 X-chromosome and either another X-chromosome (to make it a girl) or a Y-chromosome (to make it a boy). Include at least one of all the other organelles, but you might want to add a few of each kind for variety.

8. Make sure that all organelles are submerged into the gelatin and let them set in the refrigerator for at least 3 hours.
9. Cut the cells apart with a knife and use a spatula to place them on a paper plate for dissection. They are quite sturdy and will not melt or fall apart easily.



EXPLORATION

Materials:

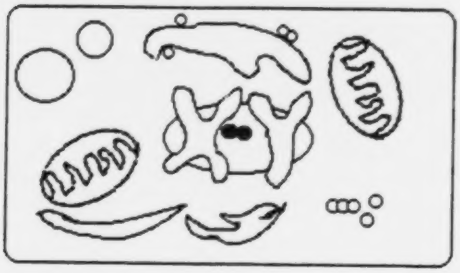
(a) Cell Dissection Lab sheet
(b) Animal cell jigglers made the night before
(c) Tweezers
(d) Paper plate
(e) Paper towels
(f) Pencils

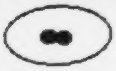
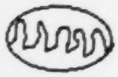
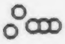
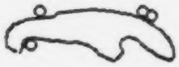
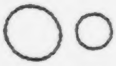
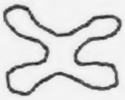
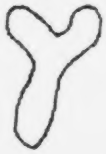
Procedure:

Group two to three students together. Each group member must fill out a Cell Dissection lab sheet. Each group will also need one animal cell jiggler on a paper plate, tweezers, and a paper towel. Instruct the groups to read all of the lab sheet instructions before beginning the dissection. Emphasize the importance of good behavior during this lab period (jello throwers spend time in the principal's office!)

INFORMATION SHEET FOR TEACHERS

PICTURE OF AN ANIMAL CELL JIGGLER



NAME OF THE ORGANELLE	PICTURE OF THE ORGANELLE	FUNCTION OF THE ORGANELLE IN THE CELL
NUCLEUS		It is the brain
MITOCHONDRIA		It is the powerhouse
RIBOSOME		It makes protein
ENDOPLASMIC RETICULUM		
VACUOLES		Storage and garbage
X CHROMOSOMES		Sex Chromosome
Y CHROMOSOMES		Sex Chromosomes

CELL DISSECTION LAB SHEET

Name________________________________ Date________________

(**STOP!** Do not begin dissecting until you have read all of the directions.)

A. Draw your animal cell jiggler and all of its organelles in the space below. Be as accurate as possible.

B. Carefully use the tweezers to remove organelles one at a time from the cell.

C. As each organelle is removed, write down its scientific name on one of the blanks below. Draw a picture of what it looks like next to the name. Some cells have more than one of each kind of organelle. Count up each kind and write the number next to the picture you have drawn of it.

SCIENTIFIC NAME OF ORGANELLE	PICTURE OF ORGANELLE	NUMBER OF THIS KIND
________________________		
________________________		
________________________		
________________________		
________________________		
________________________		
________________________		

Name________________________________ Date_______________

D. Copy the names of each organelle from the previous page. Write down what each organelle does in the cell.

SCIENTIFIC NAME OF ORGANELLE	WHAT DOES IT DO IN THE CELL?
____________________	________________________________
____________________	________________________________
____________________	________________________________
____________________	________________________________
____________________	________________________________
____________________	________________________________
____________________	________________________________

E. Each cell has 2 chromosomes which determine its sex. Use your textbook to find out whether your cell is a boy or a girl. Circle the correct answer below and explain why.

IT'S A BOY IT'S A GIRL

F. Describe the differences between the animal cell jiggler and a real animal cell.

G. What would the gelatin substance of the animal cell jiggler represent in a real animal cell?

PETS ON PARADE

Objectives:

Students will . . .

1. Describe and report on their pet or a pet of a friend or relative.
2. Compare the structure and anatomy of various pets.
3. Gain knowledge of animal behavior and social patterns.
4 Give an oral presentation to a lower grade classroom during a pet parade.

(**NOTE TO THE TEACHER**: Before this activity you will need to persuade a lower grade teacher to allow your class to go in and give an oral presentation about their pets. Clear this activity through the office, since there are some animals that should not be brought to school due to health department restrictions. Be aware that many asthma sufferers are sensitive to animal fur. You might want to prearrange for them to go into another classroom during pet parade day. Keep your lesson plans less structured on pet parade day, for you never know what will happen!)

DAY ONE

Anticipatory Set:

Announce to the classroom that they will be having a pet parade during of the week. On that day they will bring their pet from home. If they don't have one, perhaps a friend, relative, or another classroom's pet can be used. Ask the class to set the parameters of what animals they feel can be brought to school. Horses, large dogs,(unless Mom or Dad can supervise) or poisonous snakes are a few examples of pets to be left at home. Take some class time to make sure that everyone in the classroom will have their own pet or share a pet for pet parade day.

DAY TWO AND DAY THREE

List on the board all of the pets that the students say they will be bringing on pet parade day. Group the students with dogs together, cat people together, small rodents, fish, turtle, snakes, etc. together. Each group will research their pet using the classroom or school libraries.

Each pet owner must find information concerning their pet's classification, natural habitat, what it eats, how and when it sleeps, and its social structure. Each member of the group must write an original anecdote about an experience that they had with their pet. The group's work must be placed in some type of a portfolio. Picture and drawings of the animal's habitat, or behavior, a brief report, and original stories should be included.

DAY FOUR - PET PARADE DAY!

Materials:

(a) Old newspapers
(b) Fresh fruits and vegetables
(c) Fresh water source/a few plastic water dishes
(d) Twine and cardboard boxes
(e) Perhaps some Valium to calm the teacher! (optional)

Procedure:

This day can be a wonderful learning experience if it is well planned before hand. Arrive early. Separate animals that are natural enemies such as cats and dogs. I usually make a deal with the janitor to keep the cats in his work area until it was their turn in class. I have found that one or two small dogs are enough to represent the canine classification without wrecking your classroom. Make sure that enough water is available for the pets to drink. Do not expose the pets to extremely hot or cold temperatures and see to it that they are comfortable at all times.

Begin to classify and compare pet anatomy by starting with the biggest animals first. As a student holds his dog, lead the class in a discussion that the dog is a vertebrate and a mammal; talk about the variety and behavior of the species, etc. Set a time limit of 5 to 10 minutes for each animal. As they are presented, write down on the blackboard the different animals and a few of their characteristics on the board.

As the animals or class become distracted or excited, slow down, take a break, or examine a placid animal such as a guinea pig. Use this once in a life time experience to let the children really enjoy the animal kingdom. Even older students enjoy sitting on the floor or outside in the grass, and playing with a turtle or a rabbit. Count on messes, sex education taught by the animals, and disapproving looks from the teacher next door!

Send two or three students with their pets to give an oral presentation to a lower grade classroom. As these students return, send three more, until all of the pets have been presented. Offer to send the portfolios that each group put together for the lower grade classroom children to read.

DAY FIVE

Spend part of the day debriefing the class about the pet parade. Extend the lesson to include observed animal behaviors from the day before. Talk about the good and bad things that happened with the animals. Ask each student to compare two of the pets in a brief paper. Anatomical function, behavior, and social function of each pet should be included.

ALTERNATIVES TO ANIMAL DISSECTION IN THE CLASSROOM

Here are some other alternatives to animal dissection which a teacher can use in the classroom.

ANATOMY WITH CLAY MODELS

Students can use modeling clay to construct models of the phases of mitosis and meiosis of cells, frogs or other animals. Clay works very well when detailing external and internal anatomy. Use old dissection manuals or textbooks to provide details for students who are building an animal.

COMPUTER-BASED DISSECTION

There are several computer-based dissection-simulation software packages available. The computer or media coordinator of your district will be able to get you a list of dissection-simulation software packages available in the market.

OWL PELLETS DISSECTION

Owls eat 12 to 16 small rodents, birds, amphibians, and snakes a day. They swallow their prey whole. Their digestive system dissolves everything except for the bones, fur and feathers which are compacted into pellets. The owl coughs up pellets which contain complete skeletons of 4 to 6 animals. There are several owl pellet kits available. This lab is a favorite of many biology teachers. It is dry and clean, without any preservative odors. The students can classify the bones of the animals found in the pellets and actually build skeletons of small birds and rodents. Check local zoos, barns, and wildlife preserves; they may offer owl pellets without charge.

FLOWER AND SEED DISSECTION

The anatomy of flowers and seeds can be studied using dissection. Students can still experience hands-on use of dissection instruments without probing animal tissue. Begin by asking students to bring a variety of fresh flowers from their homes or neighborhood. Soak seeds overnight for easier separation during lab time. Botany reference books and microscopes should also be made available.

PRE-DISSECTED ANIMALS

Find a local junior college or university and make friends with the professor who teaches anatomy and physiology. Thousands of pre-med students dissect cats, fetal pigs, and even human cadavers every semester. These animals have been embalmed and injected with latex. Call at the beginning of a semester and ask the professor or lab assistant if he or she would please hold a cat that has the muscle groups and nerves dissected, another one with the internal organs dissected, and finally a male and female with the reproductive systems dissected. I have found that lab assistants will be happy to find and hold for you specimens that were dissected neatly and correctly.

After you have picked up your cats, about six weeks into the semester, display them outside your classroom on a table. This will help eliminate nausea caused by the odor. Provide probes, dissection manuals and let your students rotate from one cat to another.

They can still see all of the wonderful things found inside animals without the interference of cost, time, or a weak stomach. Return the specimens to the college where you got them from, so that they can be disposed of properly. Don't throw them in the school dumpster, for you will scare the janitor to death, and you will be breaking the law.

Some colleges will provide tours of their facilities and let you see human cadavers in various stages of dissection. I personally don't recommend this for a class field trip, but you may come across some strange student like my younger self who would find an individual tour fascinating.

SUGGESTED ADDITIONAL READING

Finch, P.E. (1991). Alternatives to dissection. East Haddam, CT: NAHEE, Publishers of Kind News.

MAC ATTACK!
OR
THERE'S A COMPUTER IN MY CLASSROOM AND I'VE HEARD THEY BYTE

(For Teachers of all Grades)

By olivia free-woman

It fits right up there with the urban myths about the woman who tried to dry her poodle in the microwave and the girl in the prom dress whose name was later discovered on a tombstone. If the truth be known, computers do not bite. They eat data, gobble disks and munch bits, but there has never, ever been one substantiated report of a computer devouring a teacher. Computers are nothing more than molded plastic with a few bits of solder inside. And, should a comparison be made, you are far superior in intelligence.

So what should you do if one morning you walk in to your classroom only to discover that sometime in the night the computer fairy has delivered a CPU to your desk? Use it, everyday, with as much dedication and devotion as you give to your toothbrush.

Okay, look at it this way. Automobiles are very complex pieces of machinery, but I bet you drive one. You may not know what difference the differential makes, or where the constant velocity joints are, or why the tappets shouldn't tap. And yet, you've probably hurled down the highway at seventy miles an hour in one of those hunks of fiberglass and metal. Well, I promise you, if you can back the car out of the driveway, you can run that computer.

"YEAH, BUT WHAT IF I BREAK IT?"

You won't. Unless you are planning on watering it, using it as a hot plate to warm your coffee, or storing sticks of confiscated bubble gum in it, you are not going to break it. Computers are pretty darn durable and the things you are going to do with it, like turning it on, typing on the keyboard, and telling it to print, are not going to do it any harm whatsoever.

"SO, WHAT DO I DO FIRST?"

Ask for help. Find someone you have seen sitting at a computer in the library and ask them to show you the basics. How to turn it on. How to get to the word processing program (that's the program that lets you use the computer like a typewriter). How to save what you type. How to open a document. How to close a document. And how to print something out on the printer.

That's it. That's all you need to know right now. Now, you are ready to start using that thing every day in every class you teach.

"HOW DO I DO THAT?"

Easy. Set up a routine. The nice thing about routines is the students can do them for you, like collecting homework and taking the lunch count. All you need to do is establish little chores for students to do on the computer. Every day, teach your three best students how to do them and let them teach the rest of the students.

For example, it's Jane's turn to post the homework assignment for math. The last five minutes of class, Jane goes to the computer (you turned it on when you got to school first thing this morning, all by yourself, I might add). She types in the date, the class, the page number in the book and the problems that are to be done. She prints out a copy which she staples on the bulletin board under the label "Math Sixth Hour: Homework Assignment." She returns to the computer and closes the document, saving the information.

Voila! You have just utilized the computer in your classroom. You've demonstrated its use as a tool and allowed students hands-on access to it.

Too contrived? Okay. How about this?

You type in a list of students for each of your classes. Each list is saved under its own title, such as "First Hour Language Class List." When it's Rudy's turn to do attendance, he opens up the class list for that hour, types in the date and an "x" next to the name of every student who is absent. He prints the list and then closes the document without saving it. You now have a printed attendance report for that class and an unmarked list in the computer ready to be used tomorrow.

The are dozens of other simple activities that can be incorporated into the daily and weekly routine of the classroom that will make that seemingly formidable object just another resource to be utilized. Consider the following.

Are reading groups keeping lists of vocabulary words? Each group has one day a week when it's their turn to add to their list in the computer. A copy is printed for each member of the group.

Is there terminology to be defined in science? Students take turns adding new terms and definitions to the list in the computer. Once a week or so, the list is printed and distributed to everyone in the class.

Are there dates to keep track of in social studies? By typing the dates and the events into the computer in an easy to do list format, a vertical time line can be created and printed out when needed for review.

"I THOUGHT COMPUTERS WERE SUPPOSED TO MAKE MY LIFE EASIER"

They can. Consider the daily recording of assignments mentioned above. Your students have gotten pretty darn good at typing in the information and posting it. Now, spend a little extra time creating a new form in the computer (all you have to do is type).

The form is like a piece of paper divided into five sections. Label each section with a day of the week. Next, type spaces in each section which asks for the same information: Subject, hour, date, assignment. Save it, giving it the name, say, "Homework Record Blank." Now, show your computer whizzes (every class is going to have them) how to use the form. (Don't worry. I tell you how in the next paragraph).

It is Monday. The whizzes open the document "Homework Record Blank." Then they issue the command "Save As." They name this new document, "Math, 1st Hour, Sept. 21." This creates a new document which looks just like the Record Blank. Now, they fill in the first section typing in the subject, hour, date and assignment. Then they print it and post it on the board. They close both the new document and the record blank, saving both.

The next day, they open up the document "Math, 1st Hour, Sept. 21." They type in the information for Tuesday, then print and post it. Then they close the document and save it.

For the rest of the week, it's the same thing:

1. Open the document for that class and that week.
2. Type in the day's assignment.
3. Print the document and post it.
4. Close the document and save.

It's only on Monday that they do anything different:

1. Open the document named "Homework Record Blank."
2. Do the "Save As . . . " command, naming the new document "Subject, hour, Monday's date."
3. Type in Monday's assignment.
4. Print the document and post it.
5. Close and save both documents.

Big deal, you say. So now the week's assignments are all on the same sheet of paper. So what.

Remember Jason who was absent last Monday, Tuesday, Wednesday *and* Thursday? Well, he just ran back into the classroom and wants to know what assignments he missed and you've got a meeting with the principal in five minutes and you still haven't made it to the bathroom yet today.

No problem. Go to the computer, open the document for the subject, hour and week that Jason was absent and print a copy of all the assignments for that week. Jason now has a list of his assignments and you can hurry to the bathroom and *maybe* only be a minute or two late for your meeting. Not bad.

"ISN'T THIS A LITTLE SIMPLISTIC?"

Yeah, it is. But the idea is to start using that computer for something other than a door stop. Get your hands on it. Get the students' hands on it. Have that thing up and running every period of every day, because the only way you're ever going to feel secure enough to *really* use it, is if you *use it*.

And once you are comfortable with it, comfortable enough to begin to play around with that mound of molded plastic and solder, the only limit to what it can do is your own imagination.

PAYLOAD TO MARS

(Grades 5-8)

By Rhonda Gross

INTRODUCTION

Satellites have become a very important part of our everyday lives. We are using satellites when the six o'clock news shows pictures of a hurricane out in the ocean, to fax a finance report, access a computer across the ocean, turn the TV to ESPN, or to call someone in another country. It is amazing that students generally aren't aware of the many ways that satellite technology is being used. I believe that it is necessary to communicate the basic design and uses of satellites to our student population, as these students will be making decisions concerning their use in the future.

Objectives:

Students will . . .

1. Consider uses of satellites.
2. Design a satellite by experimenting with various materials.
3. Label the basic parts of a satellite.
4. Use a amateur radio satellite (HAM).

Materials

(a) Weird or interesting pictures from the tabloids or science magazines, without captions (one for each member of your class).

Procedure:

Cut out weird or interesting pictures from the tabloids or science magazines, making sure to leave out the captions. Mount the pictures on construction paper. Remember, there should be one picture for each member of your class.

Pass out one picture to each member of the class. Explain to the class that they should pretend that their picture was taken by a satellite orbiting the planet Mars. They are to write a silly caption concerning the picture and satellite-based space exploration. Give them a 5 to 10 minute time limit to complete the task. Encourage each person to share their silly captions with the class. You might want to put these pictures up on a bulletin board afterwards.

EXPRESSION

Discuss with the class how Americans are not knowledgeable concerning satellite-use and the kinds of things satellites might find in outer space. Some members of the class may want to express their beliefs concerning UFO's or extraterrestrial life. Ask members of the class to express their opinions about our government sending out space-probe satellites and if they think that space exploration is necessary.

EXPLORATION

Materials:

(a) Clean junk such as: shoe boxes, tuna cans, foil, popsicle sticks, pop bottles, etc.
(b) Hot glue guns (teacher supervised)

Procedure:

Assign 3 to 4 students to a group, and give them a pile of clean junk to select their materials from. Tell them that when scientists design a satellite they must ask themselves what they think is necessary to put on the satellite. Instruct the students to design a space probe satellite that will be sent to Mars. Each group must decide what is necessary for the exploration of Mars. Remind them that in outer space atmospheric drag or gravity doesn't matter. The groups may use textbooks or the teacher as an information resource. This activity will probably take 1 to 2 class periods.

LABELING

Materials:

(a) Small slips of paper
(b) Marking pens
(c) Tape

Procedure:

After the satellites are finished, ask the entire class to collectively view each group's satellite and see if they can identify the various parts of the satellite. The class will probably agree that they lack the vocabulary to define parts of another group's satellite because they didn't build it. Encourage a member from several of the groups to explain their satellite design. The teacher should accept contents as diversified as an ice cream machine or a bowling alley. These type of items may seem silly, but might be important to students.

State that when scientists design satellites there are two basic parts. Define the part of a satellite that is called the "spacecraft." The space craft itself has the propulsion system, fuel, launch and landing equipment, and protection from the hostile space environment. Scientists call it the "bus." Ask the class to speculate as to the definition of what the "payload" of a satellite is. Take all answers and write them on the board. Have the class come to a consensus definition which basically states that the payload of a satellite is anything connected with the spacecraft providing communication back to earth, taking electronic pictures, sensing temperature, conducting experiments, etc.

Pass out the paper, marking pens, and tape. Instruct the groups to label the parts of their satellite, and include the words payload or spacecraft for each main part. If they are unsure about one of the parts, encourage them to ask another group for help.

APPLICATION

The most exciting and rewarding thing to do when learning about satellites is to actually use one. There are several satellites to which amateurs have access. One is called the DOVE, it is an open access satellite for HAM radio operators. If you contact a local amateur radio satellite club (HAM) one of their members will gladly come to your school and give a demonstration to your class and allow the students to actually use a HAM radio to contact DOVE, DOVE OSCAR 17, DOVE MICROSTAT or other satellites. Some students may be interested in forming an amateur radio club in school. They will need to contact one of the following organizations:

1) Radio Amateur Satellite Corporation
(AMSAT-NA)
P.O. Box 27
Washington, D.C. 20044

2) National Amateur Radio Association
16541 Redmond Way
Redmond, WA 98052

3) American Radio Relay League
Attn: Educational Activities Manager
225 Main Street
Newington, CT 06111

SUGGESTED ADDITIONAL READING

Rossie, John P., (1991) Handbook two for aerospace education. Ann Arbor, MI: Prakken Publications.

RELATIONSHIPS IN SPACE

(Grades 5-8)

By Rhonda Gross

INTRODUCTION

Size and distance are two easy concepts to teach here on Earth, but when students take them into outer space they are very difficult relationships to grasp. I remember when my first grade teacher had the class march off the relationship of distance and size of the planets in our solar system. The Earth was the size of a pea and Pluto was two blocks from the school grounds! Thirty years later I can still visualize it. Older elementary students can still benefit from visual and tactile activities while learning large numbers and great distances.

Objectives:

Students will . . .

1. Express distances and time using scientific notation.
2. Determine planet size ratios using a chart.
3. Arrange planets in order according to diameter, from smallest to largest.
4. Apply information from a chart on scientific notation and ratios to determine planet distances from the sun.

ACTIVITY ONE

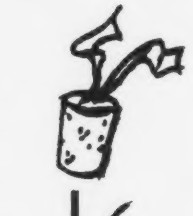
Materials:

(a) Vinegar rocket-launcher
(b) Quart soda bottle
(c) Cork with streamers attached to it with a thumbtack
(d) 1/2 cup water
(e) 1/2 cup vinegar
(f) 1 teaspoon baking soda
(g) 4 in. by 4 in. piece of paper toweling

Procedure:

Sprinkle baking soda on the paper toweling. Roll up the paper and twist the ends. Pour the water and vinegar inside the pop bottle. Take the bottle outside and drop the paper toweling into the bottle. Close the bottle tightly with the cork. Stand back and wait. The baking soda reacts with the vinegar producing $C0_2$ gas. When enough pressure builds up, the cork will shoot skyward with a loud pop. Have your class watch the launch.

Return to your classroom after the launch, and ask several students to guess how far the cork flew up in the air. Record their answers on the board. Ask several other students how long the cork was in the air, and record their answers. Discuss the differences in the students' guesses. Lead the class to consider the mathematical accuracy necessary to land man on the moon or send a satellite to orbit another planet. Emphasize the distances, time frames, and unseen dangers which scientists must foresee and incorporate into their calculations.



ACTIVITY TWO

LABELING

"Scientists and engineers need to compute very small or very large numbers. Computer time is measured in split-second increments, and vast distances as found in space are measured in light years. Have any of you ever heard the Astrophysicist Carl Sagan say something like, 'Billions and billions of stars.'?" "Well, someone needs to teach him about scientific notation. Can you imagine some poor scientist spending half his or her day writing zeros? And what about multiplying and dividing all of those zeros? These are two of the reasons why scientific notations are used."

Give your students several problems to solve the long way, such as the following four.

- What is 6.23 X 10,000? (The answer is 62,300)
- Calculate the answer to 347.1 X 100. (The answer is 347,100)
- What is 24 divided by 100? (The answer is 0.24)
- Calculate the answer to 2.89 divided by 10. (The answer is .289)

EXPLANATION OF SCIENTIFIC NOTATION

A. The number in scientific notation is written as a number between 1 and 10 times a power of 10. There will be a digit in the ones column with all other digits to the right of the decimal.

B. Refer back to problem #1: 6.23 X 10,000 = 62,300 and solve it using the following steps.

C. Note the following pattern:

10 = 10 = 10 to 1st power
100 = 10 X 10 = 10 to 2nd power
1,000 = 10 X 10 X 10 = 10 to 3rd power
10,000 = 10 X 10 X 10 X 10 = 10 to 4th power

D. Problem #1 becomes 6.23 X 10 to the 4th power.
It is written as an exponent 6.23 X 10^4

E. To multiply by powers of ten, move the decimal point to the right using the numerical value of the exponent. For example, if the exponent is 3, move the decimal point three places to the right, and if the exponent is 6, move the decimal point 6 places to the right. In the problem 6.23 X 10^4, the decimal point was moved 4 places to the right of 6.23, for an answer of 62,300. Solve problem #2 as another example of multiplication using scientific notations.

F. Explain how to divide by a power of ten by referring back to problem #3.

G. Write 24 divided by 100 as an exponent, which is 24 divided by 10^{2}.

H. To divide by a power of ten, move the decimal to the left by the same amount as the numerical value of the exponent. The problem 24 divided by 10^2 = 0.24. The decimal has moved 2 places to the left.

I. Use problem #4 as another example of division using scientific notations. Assign several other multiplication and division problems to groups of two students each for guided practice. Some students may benefit from an independent practice of 5 to 10 problems.

ACTIVITY THREE

Materials:

(a) Scientific Notation and Planetary Information Sheet
(b) Modeling clay
(c) Baseballs, golf balls, basketballs (borrow all sizes of balls from the P.E. coach)
(d) Large or small round fruit and spices (mustard seeds, peppercorns, etc.)
(e) Calculator (optional)

EXPLORATION

Divide the classroom into small groups and give each group a Scientific Notation and Planetary Information Sheet. Instruct each group to look at the planet diameter portion of the sheet. Define "diameter" if necessary; it is the distance across the middle of a sphere (in this case the planets.) Review ratios by asking the students which planet's diameter is 4 times greater than Earth. (4 times 8,000 = 32,000, so Neptune's diameter is about four times greater than the diameter of Earth.)

Ask the class which planet is about half the size of Earth to show another way to solve for ratios. Place Pluto's diameter over the Earth's diameter and write it as a fraction, 3,700/7,900. Either reduce this fraction or divide the numerator by the denominator to determine that Pluto's diameter is approximately half that of the Earth's diameter. Each group should use the earth's diameter to solve for the ratio of the other planet's size to earth's size.

After all the ratios have been calculated each group should use balls, spices, fruit or modeling clay to accurately represent the size relationships of the planets.

SCIENTIFIC NOTATION AND PLANETARY INFORMATION SHEET

SCIENTIFIC NOTATION

NAME OF PARTS OF A SECOND	HOW PARTS OF A SECOND ARE WRITTEN WITHOUT USE OF NOTATION	SCIENTIFIC NOTATION
1 Terasecond	1,000,000,000,000	10^{12}
1 Gigasecond	1,000,000,000	10^{9}
1 Megasecond	1,000,000	10^{6}
1 Kilosecond	1,000	10^{3}
1 Second	1	10
1 Millisecond	1,000	10^{-3}
1 Microsecond	1,000,000	10^{-6}
1 Nanosecond	1,000,000,000	10^{-9}
1 Picosecond	1,000,000,000,000	10^{-12}

PLANETARY INFORMATION

Planet	Distance from Sun in Miles	Diameter in Miles
Mercury	36,000,000	3,000
Venus	67,000,000	7.600
Earth	93,000,000	7,900
Mars	142,000,000	4,200
Jupiter	483,000,000	84,800
Saturn	886,000,000	75,100
Uranus	1,782,000,000	30,900
Neptune	2,793,000,000	33,000
Pluto	3,670,000,000	3,700

A light year is 6 trillion miles 6^{10} and is the distance light travels in a year.

SOURCE

Diamond, Susan U. (1985). Futuring, solving tomorrow's problems today. Pleasantville, NY: Sunburst Communications.

Zim, Herbert. (1963). Stars. New York, NY: Golden Press.

ACTIVITY FOUR

Materials:

(a) Flashlight
(b) Scientific Notation and Planetary Information Sheet
(c) Calculator
(d) Four sets of four-meter-long cords
(e) Masking tape and markers

Procedure:

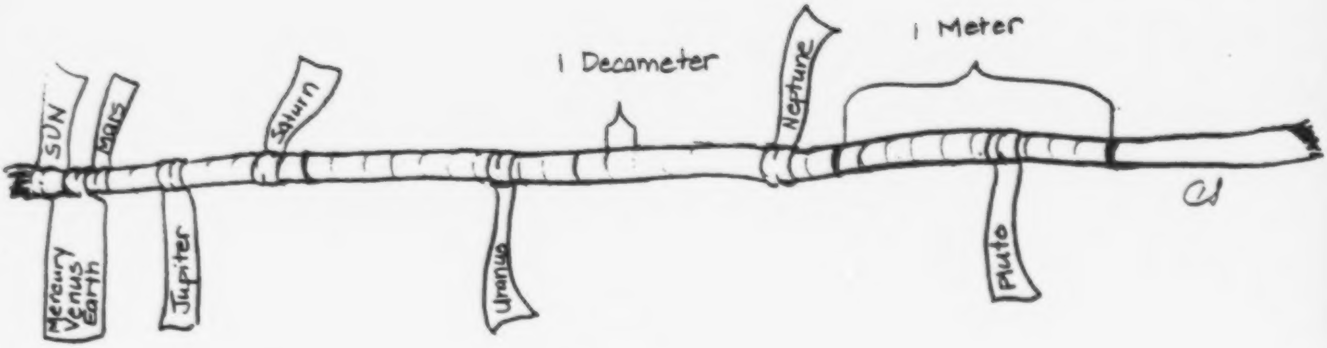
Darken the classroom, hold up a flashlight, and quickly turn it on and then off. Ask the class if they could see the light come out of the flashlight and spread out across the room to dispel the darkness. Instruct the class to watch again, more closely this time. Then ask if anyone saw it the second time. Turn the classroom lights on.

Inform the class that it is impossible for the human eye to see light actually begin to come out of a flashlight, because light travels at 299,793 kilometers per second. When an astrophysicist measures the distance of a far off star or galaxy he or she measures it in light years. Ask the class why they think that this is necessary. You should be looking for an answer that basically say: distances in space are so great that astrophysicists must use a very fast units measurement, such as the speed of light, to make numbers representing distances reasonable in size. Let the class know that in this activity they must also use one of the super fast measurements found on the Information Sheet to calculate distances in space.

EXPRESSION

Divide the class into four groups and pass out a four-meter long rope, masking tape, markers, a calculator, and Information sheets for each member. Instruct the group members to look at the Information sheets and find the planet distances from the sun column. They need to note that the distances in this column are measured in miles. The objective of this activity is to have each group decide how to use what they have learned about Scientific Notation and ratios, and apply that knowledge to computing time and distances within our solar system.

Each group will mark off one end of their four meter long rope with masking tape and label it "Sun." Each group will decide how to mark off all of the planets distances in correct order, and correct ratio distances along the rope. They will need plenty of room to spread out, and paper and pencil for calculations and planning. An example of how the four meter long rope would look is given below.


SUN
Mars
Saturn
1 Decameter
Neptune
1 Meter
Mercury
Venus
Earth
Jupiter
Uranus
Pluto

Mercury	.036	meters
Venus	.067	meters
Earth	.093	meters
Mars	1.42	meters
Jupiter	4.83	meters
Saturn	8.48	meters
Uranus	17.82	meters
Neptune	27.93	meters
Pluto	36.10	meters

A SCHOOL GARDEN: AN STS PROJECT

(Grades 5-8)

By cahal o'coileain

INTRODUCTION

Student: "Hey, what are we doing today, Mr. C? Can we go out to the garden?"

Teacher: "No, as a matter of fact, we have to finish work on coming to conclusions on our soil test experiments. If we finish early, we'll try to get out there for the last ten or fifteen minutes of the period."

Student: "OK. But if we don't, can I finish mine for homework, and go out to the garden?"

Teacher: "You mean, you'll actually choose to do homework?"

Student: "Yeah, I promise I'll do it!"

Teacher: "I never thought I'd see the day when you would volunteer to do homework!"

Student: "C'mon, Mr. C, I gotta check on my strawberries, and anyway I was gonna do some more weeding for you. Please?"

Wow. I'm really seeing a different side of this student! I wish I'd learned which buttons to push a long time ago! Life would sure have been a lot easier for all of us!

BACKGROUND

I teach in an inner city school in Phoenix, Arizona. Students in our school face problems which are similar in nature to problems faced by students in many other inner city schools across this country. Many students in our school are first-generation learners. Students in our school come from a broad spectrum of socioeconomic backgrounds. Cooperative learning activities provide a positive atmosphere for students from diverse backgrounds to learn to work together.

A SCHOOL GARDEN

For years it has been my intention to someday have a student garden at school. Upon much reflection on my longtime organic gardening hobby, I came to realize that many of the needs my students had were the same as those being satisfied for me in my garden. I mentioned the possibilities of a garden to my students, suggesting that a garden would be a good way for us to help the environment. Their immediate reaction was very positive! I could tell they were interested by the nature of the cautious how, what and where questions that followed! Where would we get tools, plants, or seeds? Who would pay for these items? Where would we put the garden? How would we keep the garden watered? How would we be able to keep it from being vandalized.

I told the students that we had a little money left in our classroom science budget. If we got creative, we certainly should be able to get people to donate things and that we could probably get some "experts" on various subjects to come in and talk with us. As far as vandalism was concerned, we discussed the possibilities of working together to monitor the garden, as well as to spread the word to others to keep their "hands off" the garden. I admitted to my students that teachers and custodians had shared their skepticism, but that I was willing to give it a try if they were. Many students live with the feeling of fear for personal property at home as well as in school, so their concerns were not unexpected. It became apparent that we were on our way when unsolicited offers of "protection" came openly from some of the more "street smart" students!

GETTING STARTED

We began our project by looking over a teacher prepared list of suggested horticultural topics, issues, and problems. Students were encouraged to choose from this or any related subject of special interest to them. What would you like to grow? What would you like to learn how to do? What problem might you like to solve? What would you like to find out about? Are there any issues that you are interested in? Students were thus allowed to choose a subject to fit their own interests and develop them in any direction according to the ability of each person. Most chose topics rather than issues to explore or problems to solve. That was all right with me, because I knew that they would be confronted by plenty of issues and problems during the normal course of events, while working with growing things. The favorite topics chosen were growing roses, carnations, planting flower beds, vegetables, cacti, terrariums, and bonsai.

A few students wanted to do leaf or seed collecting instead of working at gardening. I allowed that, and helped them find related problems to solve such as how to extract and measure amounts of chlorophyll and how to test and measure seed viability by germinating samples.

Next, students with similar interests were encouraged to form cooperative learning teams. Each team was charged with the responsibility to create a portfolio to include notes, raw data, experiments, drawings, charts, graphs, and a bibliography, all culminating in a research report of a minimum of four handwritten pages, excluding drawings, charts, etc. Each team, on completion of the project, would share their learning experiences by presenting an oral report to the class.

The school librarian agreed to allow up to six students at a time into the library to do independent research without me being present, as long as students continued to behave appropriately. She also agreed to allow students to check books out in my name to keep in the classroom as a temporary library for all my classes. The building of this temporary classroom library turned out to be a great problem solving experience for the students, as they used this library to gather information to find answers to questions. It was thrilling to watch students, who would never be caught dead with a book in their hand on campus, bring these books back to class, proudly showing me what they had found! Every class period students would rush into the classroom to ask if they could "go to the library!" They treasured the privilege of working independently of both the teacher and the classroom.

It was gratifying to witness the degree of success with which students took responsibility for their own as well as each other's behavior. Students at all ability and, more importantly, all maturity levels, flourished in the atmosphere of self-imposed discipline, coming and going unescorted in groups to and from the library. Only once, during a six week period, was a group sent back to class by the librarian for being "a little too noisy." We immediately held class discussions as to the possible termination of our library and other privileges. We focused on the "individual rights vs. the public good" issue. The students decided that a repeat offender who jeopardized their right to freely work on their projects should be sent to another classroom and given written work to do for the duration of the project. Only one student had to be so penalized.

As news of our upcoming project spread, other teachers made suggestions, and donations started coming in. One teacher's mother donated twelve rose bushes, some with new patents! A long time member of a local garden club gave invaluable suggestions, seeds, and plants. The city park district donated a truckload of planting soil mix and delivered it to the school. Members of the local bonsai society offered to come to our classroom to give a demonstration. My own interest, coupled with some knowledge and experience, was helpful, but gardening itself, by nature, is a continuous problem solving experience and I would encourage any teacher, even one with no prior gardening experience, to start one with their students.

"But I don't have a 'green thumb'!"

Nonsense! Success in growing things, like anything else, results from learned experiences.

There are no failures in gardening . Only problems to solve and conclusions to be drawn! In fact, students would probably become better thinkers and better problem solvers if teachers didn't have all the answers!

GETTING TO WORK

Our next order of business was to procure some gardening tools. This was an instance when it helped to have a good rapport with the custodial staff. We were able to borrow a rake, shovel, wheelbarrow, hammer, and a water hose from the maintenance department. As our projects began to develop and people began to see how serious we were, custodians became even more helpful, providing additional equipment, and monitoring and watering gardens before school and on weekends. They commented on numerous occasions about how they were seeing evidence of students taking pride in keeping the gardens clean, neat and well weeded. To the custodians who had the thankless task of endlessly picking up student generated litter, this was like a miracle unfolding! I noticed that they began taking more care for landscaping that they were responsible for, and in fact, periodically came into our classroom to see if *we* had information about care and maintenance of certain plants on campus!

We had class discussions about the role we were playing in helping to beautify and improve our campus environment. My students were showing a new found pride of ownership, talking about checking back next year to see how things were looking, even bringing their own children back to the school someday to see the trees that they had planted when they were in the eighth grade! Some of these students live very transient lives, moving on from one school to the next. Just think of the feeling of doing something permanent that planting a tree gives to them!

We purchased lumber and built a French intensive raised planter. Students who ordinarily do little class work were the first to latch on to this project, eager to take their turns at designing, measuring, sawing, drilling and assembling. Once I saw this happening I realized that I would be able to reprogram this activity to make it a critical thinking and problem solving experience to reach out and involve academically poor students.

Next, we laid out five garden beds in a fenced in area between two portable buildings behind the science building: a flower bed, the raised planter for vegetables, a cactus garden, a bed for grain crops, and a control plot in which we would leave the native desert soil. We removed about eight inches of soil from the first four beds and filled them with donated soil mix. Again, I was fascinated to see achievers and non-achievers, boys and girls, and students from different "cliques," industriously digging, shoveling, raking, and hauling dirt together with a common purpose!

We then assembled our wooden planter in the garden and put small nails in place a foot apart around the top perimeter. String was fastened to the nails across both the length and width, so that the planter was sectioned off into square foot planting spaces. Popsicle sticks with names of classes, teams, and students encoded on them were inserted into the soil in each square to identify their owners. As the students were now anxious to begin planting immediately, I had to make a quick trip to the home supply store to purchase the rest of the needed seeds, plants, and soil amendments, namely, peat moss, vermiculite, perlite, bone and blood meals. Since we live in the desert, the soil lacks certain nutrients as well as the organic materials necessary to hold moisture. Adding organic materials reduces the need for watering and improves soil texture and "life" conditions for non-desert plants.

At this point, much to the students temporary dismay, we took a break from the garden and returned to the classroom. It was time to learn about "nature's technology," the creation of topsoil, a task that takes nature about five hundred years per inch in depth to accomplish!

"But we're ready to plant!" they protested.

"Hey, you guys, we're going to have some real fun now, doing some lab work that you're going to really like!" I told them. After eight years of traditional school curriculum, students just don't trust teachers to keep things interesting!

LEARNING EXPERIENCES

I brought in samples of homemade compost and soils from my organic garden, which we compared to samples taken from the school garden area. We did a number of team problem solving activities, testing the samples, and making observations on their ability to hold and retain moisture. Another experiment had students dissolving samples in water in graduated cylinders, allowing particles to settle out in layers. We were then able to make observations about quantitative relationships between organic and inorganic soil components in various samples. We learned about the origins and uses of vital inorganic and organic plant and animal materials that make up soil. Student questions and responses during discussions made it obvious that they had realized that dirt was much more than just something to "cover seed with."

"Mr. C., can we plant things in different kinds of soil and see what happens?"

"Can we experiment with fertilizers and watering?"

You bet we can!!!

It doesn't take much to awaken young peoples' natural curiosity. If this is followed by activities that permit them to explore, design and create in directions that natural curiosity takes them, students become self motivated. The desire to learn is inborn in all of us. That is something to think about!

We resumed our classes out in the garden. After selectively enriching certain plots and putting soaker hoses in place, the radish people planted radishes, strawberry people, strawberries, cactus people, cacti, etc. Meanwhile, the rose people were anxious to get their projects going.

We had a fifteen by fifteen foot bare soil plot around the flagpole in front of the school, surrounded by lots of the usual utilitarian concrete. What a great place for the students to plant their rose bushes! There was even a sprinkler system in place! The students could proudly display their handiwork for the whole world to see! The principal gave permission to plant the roses on the condition that we guarantee to keep the garden neat and well maintained.

Students, teachers and custodians warned me not to plant roses there as hundreds of students walked through the area every day, going to the office, to the multipurpose room and to and from the buses. The area was also in front of locked gates, open to a busy city street. This garden would be quickly destroyed, I was assured.

We discussed the problem in class, talking about issues such as negligence, and the crimes of theft and vandalism to our own homes and personal property, and the social responsibility citizens have to report crimes vs. petty tattling. We talked about our common concerns about protecting our environment globally, regionally and locally in our city, homes and school. The students agreed to monitor the rose garden during weekdays. Some students who lived in the neighborhood volunteered to keep their eyes on the rose garden even during weekends!

During the next few days, classes went to the rose garden and learned the fundamentals of soil preparation, root and stem pruning, and planting roses. Every few days, time and schedule permitting, the rose team people were issued passes to go out to the garden and weed, water, fertilize or mulch, as necessitated by decisions made based on their observations.

While teams were out working in their garden plots, they made observations, collected and recorded data, analyzed data and came to conclusions. Students were learning higher level critical thinking skills generated by questions to answer, issues to consider and problems to solve.

Students were learning about cause and effect relationships. Which plants are the greenest, the tallest, have the most leaves, the largest leaves, the most branches, the most buds or flowers? How much? How many? What size? What seems to affect plant growth? What do we do about plants stunted by overcrowding? What do we do about the soil drying out too quickly? Where is the morning or afternoon sun? How does water, sun, nutrients or soil affect my plants? It was a great experience to see the students, instead of the teacher, generating good questions! The students were *doing* science!

GROWTH

The day the first rose bloomed was very exciting. As more of the roses bloomed in many colors, staff members commented and told of their appreciation at having something so beautiful to look at!

"Can I pick a rose and take it home to show my mother?" one of the rose people asked.

I had a tough judgment call to make.

"Can your mother come to school to see them?" I asked.

I realized that what they were really saying was that they wanted to *give* them to mom and after all, they did grow them! Then again, lots of students on campus would like a rose to present to their friends. Here we had the makings of another learning experience, namely, individual needs vs. the social good!

"You know, all the students, teachers, and visitors seem to be enjoying looking at the roses. Also, I'm concerned that if even one of you is seen with a rose or worse yet, picking one, students from other classes will think it's OK to do it themselves. So far you guys have done a great job setting a good example for other students who have shown respect for you and your garden by looking and not touching. You have also done a great job improving and teaching respect for the environment here at school. Do you have a place at home to take what you have learned, and grow some roses for your mom?"

In fact *that* is what was beginning to happen. Some students were now making little gardens at home, and growing flowers and vegetables! We were hearing about trips to the nursery to buy seeds and plants. One girl, a special education student informed me that her mom was very excited about her learning to do this in school, because she had "always wanted to have a garden to grow fresh vegetables." The last week of school she presented me with a beautiful, large, green, homegrown cucumber. "And we didn't use any chemicals either," she said proudly. Very special, indeed!

COMMENTARY

As was to be expected in doing such a school garden project, some results came out better than others. We had successes. We made mistakes. We solved problems. We learned. As food plants grew and ripened and flowers bloomed in the gardens, as related projects began to take shape, it was satisfying to observe students' interest and pride in their accomplishments. It was also interesting to see which students began to "blossom" at the various tasks each had chosen. Students at every ability level and across ethnic and cultural lines became intensely involved, working busily together. It was great to see the cooperative interplay between students who previously seemed unaware of each other.

Working on our team horticultural projects, we settled into a routine. Students came into the classroom and we took attendance. Each team then gave a brief report on the progress of their project. We shared ideas and made suggestions in response to problems. Individual team members then proceeded out to the gardens to tend or to observe and collect data, to the library to do research, to the campus to collect things, or into the adjoining lab to work on terrariums and to do experiments. Some stayed in the classroom to work on reports, drawings, posters, charts, graphs, or to confer with me. It was great to see students who had previously been uninvolved in the classroom become motivated to read, write, gather, measure, dig, plant and nurture! They were learning and having fun at the same time!

I saw my role here as a guide and resource person. The students were left pretty much on their own out in the gardens. Much of what one learns, about growing things comes from watching them on a daily basis, analyzing, reading, and asking questions. The same information could have been "taught" by the teacher in the classroom through a lecture or by having the students do work sheets. But what would be the relative value of such a *"learning experience?"*

During the course of our unit, we were able to relate to and discuss many issues of current global importance: population growth, water and energy requirements for different agricultural methods, chemical poisoning of water supplies, deforestation, extinction of plants and animals, soil erosion, waste, drought, famine, world food distribution, the economics of raising plants and animals as food, biotechnology, hybridization, carbon, nitrogen, and water cycles, and more. I thought that students showed much more than the normal interest in these discussions because they were personally involved in doing "hands-on" activities. Next year we will take our study of the earthworm out of the unit on invertebrate animals and move it to our gardening project, where it should have much more meaning to the students.

As teachers we are hearing about new techniques to encourage student involvement in the classroom. My garden project is closely structured on one technique known as the learning spiral. The following math/science lesson uses the learning spiral technique and also involves the school garden.

THE SIZE OF THE SCHOOL GARDEN: A MATH/SCIENCE LESSON

BACKGROUND

This past year, a group of students, I euphemistically refer to as "period 2," came gamboling and cavorting into science class. During the ensuing months, they fiddled and fooled. We grouped, and regrouped. We "worked" independently, on self esteem, had rewards, punishments and parent conferences. We counseled, threatened and cajoled, monitored and adjusted. We varied content, methods and learning styles. Everything worked well for the first five minutes. I pulled every last management trick out of the bag. We were lucky to get ten productive minutes each class period and I wasn't even angry with them! Learning activities that students in other classes eagerly participated in, was of little interest to this class. Inappropriate behavior was the norm. They fell far behind the other classes.

What we were seeing here was the downside of homogeneous grouping. Bright students with leadership potential had been culled out and placed in algebra classes. Other classes were left with an inordinate number of students with average and below average abilities and correspondingly low *academic* self-esteem.

My wife taught math at the same school. She was a third year, non-tenured teacher. I had many years of experience in the classroom. She and I had spent endless hours discussing our classrooms. At some point we discovered that she had an eighth grade class of bright, high achieving algebra students during "period two." Could a benefit be derived from having our two classes work together? Would they be able to work together cooperatively? Would students with such differing academic backgrounds accept each other? Could we design a math/science lesson that would challenge all of these students? We decided to give it a try.

We came up with a learning spiral, cooperative learning model, that, hopefully, would challenge students at the level of ability of each individual. We called this lesson, "The Size of the School Garden."

We were very excited about doing this lesson together for a number of reasons. We saw the opportunity to give our students some exciting and valuable new experiences in learning, as well as our having the mutual benefit of sharing our teaching experiences.

The lesson was designed to teach the concepts of area and perimeter using the school garden. It was also designed to include, incorporate and provide the following middle school strategies:

1. Interdisciplinary instruction involving both math and science.
2. Team teaching involving math and science students and teachers.
3. Peer coaching and mentoring which provides for the possibility of both newer and experienced teachers to work together.
4. Spiral Learning- learning at the level of application and critical thinking.
5. Cooperative learning.
6. Cross house student involvement
7. Environmental awareness and action.
8. A Science, Technology and Society oriented curriculum to teach science and technology in a social awareness context.

BEGINNING

When the algebra students entered the science class, both groups of students sat quietly, bemusedly sizing each other up. The science students had never sat so quietly! The algebra students had never been in this particular classroom before. My wife and I had spent a good deal of time discussing our individual classes and had put the students in teams, balancing them according to gender, ethnicity, social characteristics, and academic ability. As we placed the students into their teams, there were a few giggles, groans, and comments, but on the whole this part went well. So far, so good.

Next the students were told that they were going to do an experimental lesson that would involve measuring the science garden. They were also told that prizes would be awarded to those teams that worked well together. Guide sheets were then passed out detailing the instructions to follow. We had included a small drawing on the guide sheet, illustrating the garden plot and numbers indicating starting points with arrows to keep every one measuring in the same direction to prevent chaos!

THE LESSON: FINDING THE SIZE OF THE SCHOOL GARDEN

INTRODUCTION
AND
GUIDE SHEET

Instructions:

1. Each team will have 8 minutes to measure the size of the garden.
2. Each team member will choose one of the following jobs to do:
    a. **Reader**: Reads directions to the team.
    b. **Recorder**: Draws outline of garden on graph paper while recording measurements.
    c. **Measurer**: Takes measurements using measuring stick.
    d. **Superintendent**: Makes sure measurements are made and recorded accurately. (hint - Let a team member with high science/math grades have this job!)
3. **Materials**:
    a) Measuring stick
    b) Graph paper
    c) Pencil
4. Each team will go out to the garden and stand at one of the twelve numbered spots in the garden.
5. While in the garden, each team will have a few minutes to ask questions and plan strategy.
6. When the teacher says "start," teams will begin measuring the outside outline of the garden, going in the direction of the arrows. This is important so that teams do not get in each others' way.
7. Teams should work independently, keeping their information confidential.
8. When finished measuring and recording, each team will move quickly out of the garden to a quiet place and team members will look over their work.
9. When the teacher gives the signal that the 8 minutes are up, all teams will go quickly back to their seats in the classroom.

10. Back in the classroom, each team will have 10 minutes to calculate TWO WAYS to express the size of the garden, using the numbers they have recorded on their graphs.

(What we were looking for here were the two concepts area and perimeter.)

EXPLORATION

As team members chose individual tasks indicated on the guide sheet, except for a slight bit of temporary disharmony here and there, it was apparent that the students were finding this to be an interesting project. Soon, the crowded room (46 students!) was buzzing with team conversations about who was going to do what!

The teams were then taken out to the garden, with clip boards, graph paper, meter sticks(they hadn't been told that the "measuring sticks" measured in different units), and pencils in hand. Once out in the garden, the "Readers" quickly re-read the instructions to their teammates. As each team indicated that they understood the game plan, the "Measurers" measured, "Recorders" drew on the graph paper, recording the measurements, and the "Superintendents" checked for accuracy. Some students were confused by what units they were supposed to use for measuring, while others were unaware of what the "measuring stick" was! Most of the students had been introduced to systems of measurement in physical science the year before and had done a unit on linear measurement in the metric system. We told them to figure it out the best way that they could. It was very interesting to see the students putting their heads together in serious discussions about the nature of the measuring instrument! We were seeing some real practical problem solving going on here!

As members of each team completed the tasks of measuring and recording, they were instructed to spend a few minutes going back over the work while others were finishing. When the time allotted was up, the teams returned to the classroom.

Once back in the classroom the students had 10 minutes to work with their data to calculate 2 ways to express the size of the garden. The room was now full of busy energy as each team discussed, questioned and problem solved. The teachers visited with each team, monitoring progress. Students asked such questions as, "Are we doing this right? Were we supposed to measure in feet and inches or in meters and centimeters? Are we supposed to tell the number of feet in the garden, or around the garden?" "What does your guide sheet ask you to determine? Use information that you might already know about measuring the size of things. Do the best you can. We'll see in a few minutes," we told them.

EXPRESSION

"The 10 minutes are now up. We would now like to hear from each team to see what you have figured out," we said. As we heard from each team, individual students were called up to the board to illustrate their work and encouraged to write key words on the board that they were using in their explanations. It was uncharacteristic but very gratifying to see some of the science students volunteering to come up to the board to show the class what they had done! The following list of words and terms was now compiled on the chalkboard by the students. With help from other class mates and the teachers, these concepts were expressed accurately:

Diameter
Length
Width
Square

At this juncture, class time was just about up. We summed up what we had already discussed and told the students that we would resume discussions tomorrow. They expressed satisfaction that they were going to get to "do it again" tomorrow. They had indeed had fun. We were not concerned about the fact that we had not "closed on the objective" as is usually prescribed in traditional lesson formats. The students had been deeply involved in a rather complex problem solving experience. The nature and directions that their individual inquiries had taken, dictated that more time would be needed to complete our investigation.

The next day, after each team had a few minutes to review and discuss the previous day's experiences, we resumed our discussion at the board. Individual students from each team came up and we compiled the following list of terms:

Area
Rectangle
Fraction
Decimal
Perimeter
Scale model
Inches
Feet
Yards
Meters
Meter-stick
Yardstick
Centimeters
Graph
Angles
Triangles
Degrees

As you can see, the students introduced some concepts into the lesson that appear to be non-relevant. This is not really bad, since the serendipitous nature of scientific inquiry is such that "mistakes," on quite a few occasions, have led to new problems to solve, new questions to answer and even to new discoveries (e.g. penicillin and X-rays). For example, Sarah said that the distance that she calculated across the garden was its diameter. "Sarah, can you tell us what a diameter is?" "It's the distance across something," she answered. "Yes, you are correct!" Can anyone tell us what that something is?" Eventually , after some discussion, another student came up to the chalkboard, drew a circle, and identified its diameter. We now had a good definition for the term "diameter." The point is that each concept introduced had relevance to one student or another. The shared ideas that they generated enriched the learning experience for all the students. The teachers placed themselves in the role of guides and resource persons during this exploration phase of the lesson, helping the students to "flesh out" the definitions of concepts and to see relationships between the different components.

APPLICATION

Subsequent lessons had the students measuring our raised planter and other planting beds to section them off into planting squares of different sizes. They were able to utilize the practical knowledge that they had gained from this lesson. Students who were starting gardens at home were encouraged to lay their gardens out in similar fashion to accommodate the various plants that they planned to grow.

CONCLUSION

"Mrs. C. or Mr. C, what do you mean by the SIZE of the garden?" We heard this question over and over during the introduction and exploration phases of the lesson. "Well, that's what you're going to tell us!" During the course of our discussions in the expression and labeling phases of the lesson, students were able to tell us that we could express the size as the area and/or the perimeter!

The outcome of this lesson was successful beyond our most hopeful expectations. In both the math and the science classes the students repeatedly asked the teachers if they were going to be able to work together again. The students had an exciting experience. They enjoyed working together on a lesson structured in the learning spiral format. It was interesting for us to note that in the initial measuring phase of the lesson, some of the science students were more adept at the task of taking physical measurements, but stayed absorbed as the algebra students, in general, took over, using the numbers in the calculation phase of the lesson. It was great to watch the students helping each other. It was obvious that the students were proud to be working with each other! Students in the science class who had previously accomplished very little academically, had been absorbed and involved while working with their team mates.

The very nature of the learning spiral lesson allows for a successful cooperative environment for most students. In this lesson the brighter students were not slowed down, or inhibited from attaining higher levels of critical thinking. Since, by design, the students are encouraged to explore and to share what they have discovered during exploration, higher levels of thinking and learning are given free reign. Academically slower students have the opportunity to be exposed to this and to be "stretched" by it. As the concepts are applied during follow up "spirals," re-teaching and enrichment are well provided for in such a practical way that students have a much better chance of retaining what they have learned. How is this different than traditional textbook methods of learning? It is different because students are not merely working on more examples of similar problems supplied by the teacher or textbook. In subsequently working on finding and applying solutions to practical problems as discussed in the "application" section above, they are more personally involved in utilizing learned concepts. Teachers, try the learning spiral in your classroom. You'll like it!

The learning spiral is discussed in greater detail in another article in this volume entitled, "The Learning Spiral - Try It, You'll Like It." That article is a "how to" description, showing the adaptation of this inquiry method to a variety of lessons.

SCHOOL WIDE COOPERATIVE PROGRAMMING

(Grades 4-8)

By Susan Perez and Vanessa Salas

Life is more complex for children today than it was when their grandparents or even their parents were growing up. Our world has become modernized and high tech. We're surrounded by machines and technological systems that we once saw only in science fiction movies. Technology has made our lives easier, but because of technology our lives have also become more complicated due to the damage and possible hazards we have created on our planet.

Thanks to environmental groups working to educate people, the push to save our planet is reaching all sectors of society. National and local organizations are pulling together to educate people and improve the way we live.

Because of the way our lives have changed, what and how we teach children must also change. It's become necessary to teach children not only to become complex problem solvers but also to learn life skills that will enable them to become more self-sufficient, aware, and better able to handle what lies ahead.

By integrating creative, school-wide, cooperative programs in your school, students will be better able to develop some worthwhile life skills, social skills, and thinking skills. They will also become more aware of the impact of environmental problems on their immediate surroundings.

When using cooperative programs, include activities that will generate enthusiasm and support from both students and faculty. Students and faculty working together can create a positive and cohesive school climate. Some possible activities might be a school pond, a recycling patrol, or a school garden.

Objectives:

Students will be able to . . .

1. Work cooperatively to create plans of action.
2. Identify and understand environmental problems and how they affect their surroundings.
3. Learn and work together cooperatively.
4. Identify, understand, and create an ecosystem.
5. Use calculations.
6. Recycle
7. Turn refuse into revenue.

A SCHOOL POND

A pond can be a thing of beauty, but it can also be a much more adventurous approach to the study of water than is usually possible. A pond can be a place where students can study different varieties of water plants and other pond life. A pond will become a port with ships and floating docks and a laboratory where all sorts of experiments with floating and sinking, wave patterns, stability, streamlining and many other topics can be investigated in an exciting, and practical way. A pond could have a dam with a water wheel to show how water power was first used. If the dam were in a suitable place it might be possible to use the water to set out a miniature irrigation scheme. All of this may sound ambitious but it can be done.

Purpose:

1. To provide a compact and independently balanced ecosystem.
2. To provide a valuable resource for the study of water.
3. To provide a school wide project to enhance social skills.

Materials:

(a) Wide polythene and PVC sheets (amount depends on how big the pond is)
(b) Pegs, a board, and a level
(c) Newspapers, peat or soft sand
(d) Shovel
(e) Large slabs of rock

Procedure:

The first step in building a pond is to level a site to avoid ending up with a pond which appears to have water lower on one side than the other due to a slight slope of the ground in which it is set. Before beginning to excavate, level an area of ground a little larger than the space to be occupied by the pond. The pond does not have to be deep. A deepest point of 50 cm will provide sufficient depth for the larger water plants and for enough unfrozen water for fish to survive during severe cold spells. A range of depths provide for a greater variety of plants and animals requiring different depths. Keep the sides of the excavation fairly shallow for this makes lining simpler and the edging of paving slabs more secure. Since the plastic is less expensive than concrete it is much easier to make a reasonably large pond. A good sized pond of 2m x 2.5m has advantages.

When the excavation is complete, remove all sharp stones, roots, etc., which might puncture the plastic and line it with a good thick layer of peat or soft sand. A good alternative to the peat or soft sand is using up to 2.5cm of wet newspaper. One of the best ways to do this is to have a gently running sprinkler on a hose and put down layers of newspapers, wetting and treading on them as you go. Lay down as much paper as you can. The paper will form a soft base for the plastic and will absorb any stones which may work their way up through the soil.

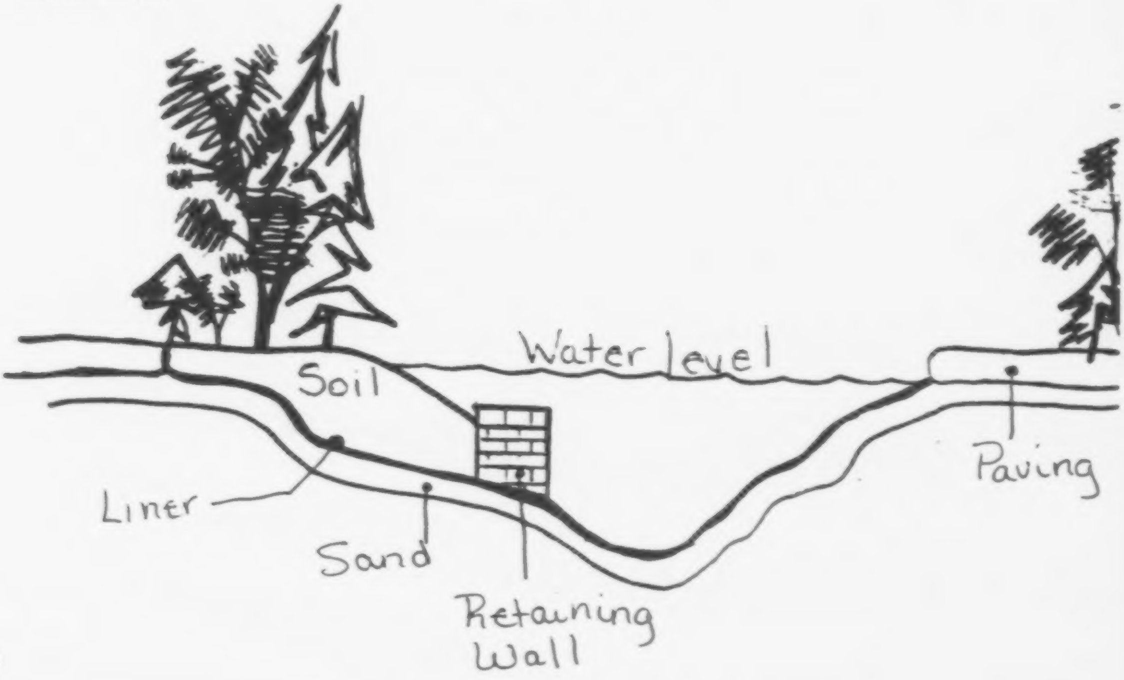
To line the pond, use heavy 500 or 1,000 grade polythene sheet, which is available in widths up to 7m, or 0.014 grade PVC sheeting or a butyl pool liner. When measuring the excavation for the size of liner to order, lay a string across the largest dimension of the hole, lowering it so that it touches the sides and bottom all the way across. Cut the string at the edges of the pond, remove it, measure its length and add 60cm. This will give you the length of the sheet required. Repeat the measurement at right angles to the first measurement and do not forget to add 60cm. This measurement is the width of sheet required.

When laying the liner do not be too concerned about a smooth finish. Run the hose into the pond and the weight of water will push the plastic to the contours of the hole and any folds will, in time, become flattened so that they are almost invisible to even close inspection. It is better to let the plastic fold naturally under the weight of water than to try to make the folds yourself and risk damaging it, although where large folds occur there is no harm in helping the water to push them into their natural position.

When the pond is completely filled with water, trim surplus plastic away with scissors, but leave an overlap over the surface of the ground of 15 to 20cm which will be held in place and covered by the paving-slab edging. The slabs should be large enough to overlap the water by about 4cm, but small enough that they do not tilt over when children stand on the edge to work. Rectangular slabs are most generally useful but large, irregular pieces of broken slab, while more difficult to arrange, give a more natural effect which may be preferable in some circumstances. (See diagram)

The pond is not intended to be a formal goldfish pool but is required to become as natural-looking and as varied in the life it supports as possible. It should become overgrown around the edges so that it soon begins to look like a natural pond instead of something constructed from plastic. To start off the water garden, stock the pond with some floating and marginal plants and then add fish such as carp, rudd, tench and golden orfe. Apart from these, the more organisms collected from natural ponds and introduced, the better. While some of the introduced organisms may not settle down and survive, many will, and the pond will soon reach a natural balance of plant and varied animal life. There will be periods of cloudiness of the water, but it is essential that these be left to disperse naturally and that attempts to drain the pool and start again are not made.

(**WARNING**: Students should not be allowed to work near the pond without adult supervision.)



RECYCLING PATROL

Recycling on any scale, small or large, can help to relieve our landfill problems. Schools can help to reduce some of the solid waste problems by curbing their own use and reusing certain materials.

Objectives:

1. Students will work cooperatively to create plans of action to reduce the problem of solid waste in their school.
2. Students will work cooperatively to collect solid waste for recycling, reducing and reusing.
3. Students will be able to calculate the number of pieces, weight, and volume of solid waste.
4. Students will be able to turn refuse into revenue by recycling.

Materials:

(a) Cardboard boxes,
(b) Plastic containers, or
(c) Bags (plastic and paper).

Procedures:

To set up a recycling center in your school or home, start by setting up several cardboard boxes, plastic containers, or bags. "Put newspapers in one bag, mixed paper in a second container, aluminum cans in a third container, tin cans in a fourth container, clear glass bottles and jars in the fifth, colored glass jars and bottles in the sixth, and plastics in the seventh" (Bird, 1991, p.2).

1. Newspaper-Stack it and bind it or put it into grocery bags.
2. Cardboard-Break down your boxes and stack them flat or stuff them into another box.
3. High-grade paper-(computer paper, white office paper, stationary, ditto paper) collect and store in boxes.
4. Mixed paper-(most household paper such as advertisements or junk mail, construction paper, butcher paper, and tissue paper) Collect and store in boxes.
5. Bottles and jars-wash them and remove the labels, metal caps and rings. Then separate them by color.
6. Aluminum cans-Crush the cans to take up less space.
7. Tin food cans-Wash the cans to remove residue, take off the labels, and crush them. (Check to see if the recycling companies will accept them.)
8. Plastics-Check with the recycling companies to find out what kinds of plastics they will accept.
9. Rubber-Discarded tires are a valuable resource but the lack of a market makes disposal difficult.

It seems simple to buy a product and dispose of the empty container or throw away our scrap materials, but what we've done in the past is to contribute to the already existing landfill problem and have actually thrown away money. By recycling, reducing and reusing we can diminish some of our existing problems such as space for landfills, and wasting the valuable resources used to reproduce new products, as well as earn extra money for home or school.

COOPERATIVE GARDENING

Gardens in a school, whether they be fruit and vegetable or flowering gardens can have both aesthetic and productive value. School gardens are an excellent project for all grade levels. Cooperative gardening can create a fun, educational working environment conducive to learning in any content area. Learning about a garden can be a very basic learning experience or could lead to more complex learning experiences such as problem solving, learning about local or global environmental concerns.

Procedure:

For information about how to create a cooperative garden, refer to the article entitled "A School Garden: An STS Project," in this handbook.

SUGGESTED ADDITIONAL READINGS

Javna, J.(1990). *50 simple things kids can do to save the earth.* Kansas City, Missouri: Andrews and McMeel, A Universal Press Syndicate Company.
MacEachern, D.(1990). *Save our planet.* New York, New York: Dell Publishing Inc.

SHAKE AND QUAKE

(Grades 7-8)

By olivia free-woman

INTRODUCTION

Measurement, whether it is length, weight or speed, allows us to make comparisons and communicate information. When speaking of earthquakes, it is the Richter scale that is used to communicate the strength of a quake and to compare it to other quakes. But the Richter scale is only one means of describing quakes. This article will examine two ways of measuring earthquakes. The first, the Mercalli scale, measures quakes according to their *intensity*, or impact on people. The second is the Richter scale which measures the amount of strain energy released, or *magnitude* of a quake.

The Mercalli scale was refined by Italian seismologist Guiseppe Mercalli in 1902 from an intensity scale which had been in use in Europe since 1883. The scale was further modified in 1931 by two Americans, H. O. Wood and Frank Neumann. The Mercalli scale currently in use uses twelve points to rank earthquakes by their relative levels of destruction, ground motion and impact on people.

In 1935, Charles Richter introduced a scale which uses a seismograph and measures the amount of energy released at the point of initial ground movement. The Richter scale starts at a level of one, increases by a multiple of 30 at each successive level and does not top out.

ACTIVITY ONE - BUILDINGS THAT STAND UP TO EARTHQUAKES

Purpose:

1. To demonstrate the impact that different types of earthquake waves have on buildings.

Teacher Background Information:

Earthquakes transmit vibrations in wave-like motions in all directions from the point of origin. These vibrations are of two types: Body waves, which travel through the body of the earth including the mantle and core, and surface waves, which travel at or near the earth's surface.

Body waves allow scientists to study the structure and composition of the earth's interior as well as to locate the epicenter of an earthquake. Surface waves are responsible for the shaking which people feel during a quake and for the damage that occurs to buildings and other structures.

Materials:

(a) 1 Plastic straw construction set per group (such as Vector Flexor®) consisting of 24 star connectors and 60 straws per set (minimum)
(b) 1 table per group
(c) 13 x 9 inch flat cake pan
(d) Water
(e) Modified Mercalli Scale
(f) Earthquake Intensity work sheet

Introduction:

Not all earthquakes are the same. Some quakes feel like someone is shaking the ground while others feel like the ground is rolling under your feet. No matter how it feels, though, earthquakes can have devastating effects on cities and the people living in them. In areas where there is a danger of earthquakes, special consideration must be given to the construction of buildings.

Procedure:

Demonstrate to students how different earthquakes can be simulated using a table and a small amount of water in a flat cake pan as described below:

1. Shake the table with quick, short sideways movements. Have students describe what happens to the water. Ask how this might feel if the water was the ground and they were standing on it.
2. Allow the water to settle and shake the table again, this time back and forth with long, gentle movements. Ask students to describe the motion of the water (rolling, like waves) and how it might feel if it were the ground and they were standing on it.
3. Show how the intensity of quakes can be increased and decreased by the speed with which the table is shaken: Very rapid, short sideways movements vs. long, rapid back-and-forth movements.

EXPLORATION

Divide students into groups and provide each group with a construction set and a table on which to work. Inform students that they are engineers and that their task is to design and construct buildings that can withstand different types of earthquakes. Like all good engineers, they will need to test their designs in simulated conditions featuring different types of earthquakes and to keep records concerning their findings.

Provide students with time to plan, construct and test their model buildings.

EXPRESSION

Ask students to describe their findings about the construction of buildings. Were there any designs that seemed better able to withstand the earthquakes? Did the way the Earth (the table) shake influence the type of building design? What impact might the possibility of earthquakes have on the design and construction of buildings?

LABELING

Present students with the background information provided at the beginning of the lesson (body vs. surface waves).

Ask students to identify the type of waves they have been investigating (surface waves). Identify for students that there are two different kinds of surface waves and provide their names and definitions:

1. **Love waves:** Love waves move sideways and are characterized by a great many waves happening in a very short amount of time. These waves produce the vibrations in the earth's surface that feel like someone is shaking the ground very rapidly.
2. **Rayleigh waves:** Rayleigh waves move up and down and are much longer than Love waves. These waves are slower and longer and feel much like the ground is rolling.

Ask students to demonstrate the two kinds of surface waves using the pan of water on a table.

Have students identify which of their building designs are better for which type of surface wave.

Identify for students that what they have been exploring is the intensity of earthquakes. *Intensity* is the effect that an earthquake has on people and their environment. The greater the intensity of an earthquake, the greater the damage is, whether that damage is the number of people killed or injured or the number of buildings destroyed.

An earthquake's intensity is measured on a scale called a Mercalli scale. The Mercalli scale goes from a level I to a level of XII. At a level of I, people do not even feel any Earth movement. At a level of XII, almost everything is destroyed. Objects are tossed into the air and the ground moves visibly, in waves or ripples.

Present the Mercalli scale and have students identify what intensity they would assign to various past earthquakes (San Francisco in 1906, Alaska in 1964, Armenia in 1988, etc.).

MODIFIED MERCALLI SCALE

I. Only instruments can detect the movement. People do not feel it.

II. People lying down or on upper floors of tall buildings might feel movement.

III. Many people indoors will feel movement. Hanging objects swing back and forth.

IV. Most people indoors will feel movement, but those outside may not. Dishes, windows and doors rattle. Parked cars rock.

V. Almost everyone feels movement. Sleeping people wake up. Doors swing, dishes break, small objects move or are turned over. Trees might shake.

VI. Everyone feels movement. It is difficult to walk. Pictures fall off walls, objects fall from shelves, furniture moves. Trees and bushes shake. There is slight damage to poorly built buildings.

VII. It is difficult for people to remain standing. Cars shake. Furniture breaks. Damage is slight to moderate in well-built buildings, heavy in poorly built buildings.

VIII. It is difficult to steer cars. Houses may move off their foundations. Poorly built buildings may collapse and chimneys may fall. Well built buildings suffer slight damage. Tree branches break.

IX. Well built buildings suffer considerable damage. Houses not bolted down move off their foundations. Some underground pipes are broken. The ground cracks.

X. Most buildings are destroyed. Bridges and dams are seriously damaged. Water is thrown out of rivers and lakes. The ground cracks in large areas. There are large landslides.

XI. Most buildings collapse. Railroad tracks are bent. Bridges and underground pipelines are destroyed. Large cracks appear in the ground.

XII. Almost every thing is totally destroyed. Large objects may be thrown into the air. The ground moves in waves or ripples.

SOURCE: Liepold, M.L. (1988).

EARTHQUAKE INTENSITY

DATE	LOCATION	DAMAGE	INTENSITY ON MERCALLI SCALE
April 18-19, 1906	San Francisco	700 people killed (estimated) entire city of San Francisco leveled by quake and fire	
March 27, 1964	Alaska	131 people killed	
Sept. 19-20, 1985	Mexico City	25,000 people killed 1000's of buildings destroyed	
Dec. 7, 1988	Armenia	25,000 people killed 15,000 injured 400,000 people left homeless	
Oct. 17, 1989	San Francisco	63 people killed 3,000 people injured 100,000 buildings damaged or destroyed	
June 28,1992	Yucca Valley, CA	1 killed apx. 125 people injured Some buildings destroyed utilities disrupted	

SOURCES: Johnson, O. (1992) and Liepold, M.L. (1988)

APPLICATION

At this time, science can not prevent earthquakes nor control how strong they are. Science isn't even able to predict when or exactly where quakes will happen. But there are things people can do to effect the intensity of an earthquake.

Have students identify what might effect the intensity of an earthquake. Look for references to how strong a quake is, the location of a quake's epicenter (near cities or populated areas) and the types of buildings that are constructed in the area of a quake. Compare the intensity of various past earthquakes (i.e.. the San Francisco earthquake of 1906 vs. the San Francisco earthquake of 1989) and ask students to identify what made the difference in the intensity between the quakes. By choosing a variety of quakes for students to compare, a variety of factors can be identified: low population density (Alaska 1964), poor construction of buildings and high density of population (Mexico 1985) and poor construction of buildings (Armenia 1988).

Have students identify which of these are within people's ability to control (where people live, types of buildings that are constructed) and how earthquake intensity could be lessened (restricting where people live, building codes). Discuss pros and cons of legally regulating where people live and the construction of buildings.

ACTIVITY TWO - EXACTLY HOW BIG WAS THAT QUAKE ANYWAY?

Purpose:

1. To explore how seismographs measure the magnitude of earthquakes.

Teacher Background Information:

The first pendulum seismographs were designed by British scientists in the late 1800's. Pendulum seismographs use the principle of inertia. A heavy weight hanging from a stand will tend to remain still even when the ground on which the stand is resting moves.

Modern seismographs use either mechanical or electrical signals. Ground motion sends signals to a pen attached to a paper-covered drum. The pen responds to the signals, recording the motion on the paper.

Materials:

For each group of students:

(a) Felt tip marker
(b) Paper
(c) 2 bricks (or other heavy weights)
(d) Bunsen burner stand
(e) Heavy twine
(f) Masking tape
(g) A table at which to work
(h) Richter Scale illustration overhead
(i) The Richter Scale information sheet
(j) Earthquake Magnitude information sheet

Introduction:

We have taken a look at one way earthquakes can be measured - the Mercalli scale. The Mercalli scale measures the affect that quakes have on people and the buildings around them. But scientists also need to measure just how much shaking an earthquake does, whether or not there are any people around to feel it or any building around for it to topple. Today we are going to build instruments that will measure just how much an earthquake quakes.

EXPLORATION

(Present the overhead) Here are some instruments that measure earthquakes. Notice that all of them are made up of the same basic components: A pen and some paper with which to record the movement of the Earth during the quake. A weight to hold the pen steady. A stand from which to hang the pen. And tape and string with which to put it all together. I'm also going to throw in an extra weight to help hold the stand steady. (Turn off overhead.)

Your task is to build an instrument that will measure just how much the Earth moves during a quake. You will, of course, have to put your instrument to the test by creating some quakes for it to measure. (Remind students of how quakes were simulated in earlier activity.)

Provide students with time to construct and test their instruments.

EXPRESSION

Ask students to describe how they built their instruments and the purpose of each part of the instrument. Assist students in identifying that the pen or marker remained still while the Earth (the table) moved under it.

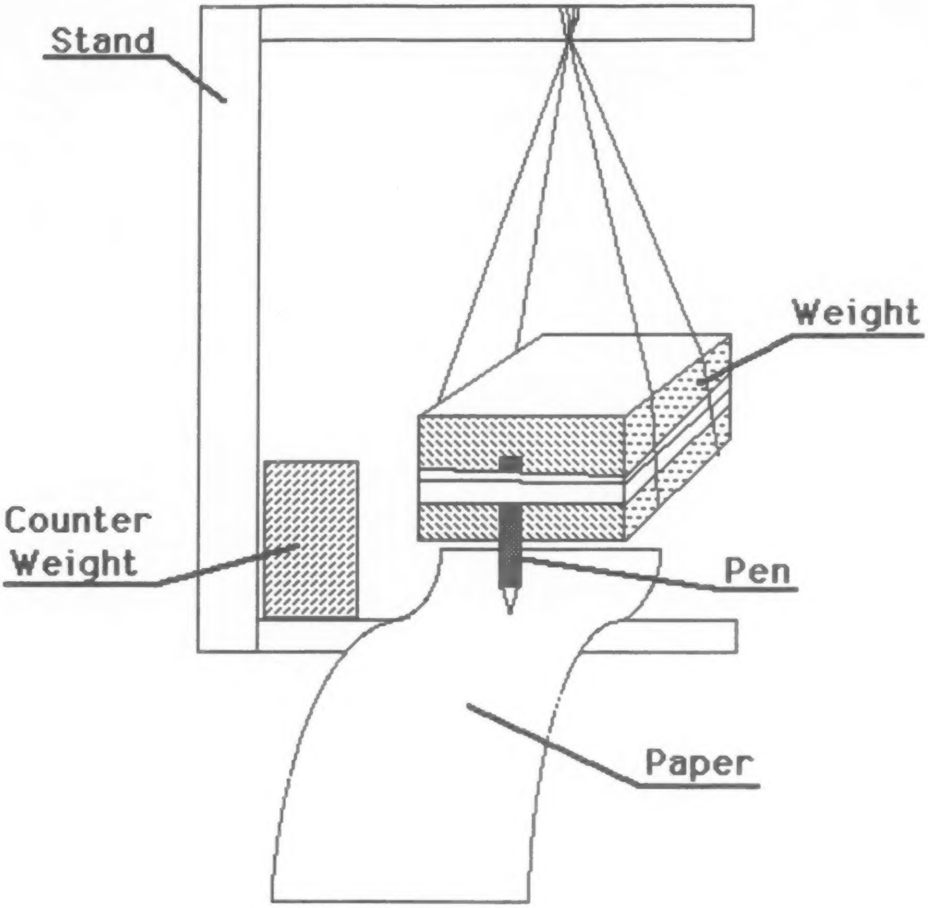
Ask students to describe what the lines made by the instruments looked like. Have students compare the different types of lines that were made by different types of quakes, identifying why some lines are long and some are short, why some are close together and some farther apart. (If necessary, have students repeat the quake tests, shaking the table differently for different quakes.)

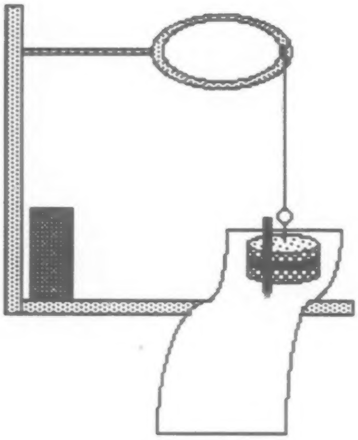
LABELING

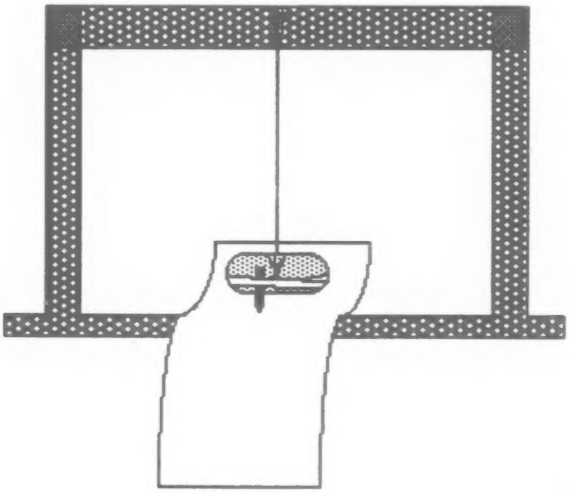
Identify for students that what they have built is a seismograph. Seismographs measure how big the waves or vibrations are that are produced by an earthquake. They record these waves of movement through the Earth as line tracings of waves on pieces of paper. The pieces of paper are called seismograms.

Shake a table slowly with very short movements. Ask students to surmise what a seismogram showing that quake would look like. Shake the table slowly with longer movements and ask students to again identify what the seismogram would look like. Look for references to the difference in size of the waves that would be drawn on the paper. The size of the wave tracing is called *amplitude*. The higher the wave tracing from the center of the paper, the greater the amplitude of the wave.

Repeat the question after shaking the table very rapidly with short movements and again after shaking the table rapidly with longer movements. Ask students to identify what else seismograms show. Look for references to how close together the waves are and how long the earthquake lasts.


Stand
Weight
Counter Weight
Pen
Paper





Overhead
by free-woman

THE RICHTER SCALE

MAGNITUDE	TNT ENERGY EQUIVALENT	EXAMPLE OF QUAKES AND OTHERS
1.0	6 ounces	
1.5	2 pounds	
2.0	13 pounds	
3.0	397 pounds	
3.5	1,000 pounds	
4.0	6 tons	small atomic bomb
4.5	32 tons	average tornado
5.0	199 tons	
5.5	500 tons	Massena, NY 1944
6.0	6,270 tons	
6.5	31,550 tons	Coalinga, CA 1983
7.0	199,000 tons	Hebgen Lake, MT 1959
7.5	1,000,000 tons	
8.0	6,270,000 tons	San Francisco, CA 1906 Mexico City, 1985
8.5	31,550,000 tons	Anchorage, AK 1964
9.0	199,999,000 tons	

SOURCES: Johnson, O. (1992) and Liepold, M.L. (1988)

EARTHQUAKE MAGNITUDE

DATE	LOCATION	MAGNITUDE ON RICHTER SCALE
April 18-19, 1906	San Francisco	8.2 estimated
March 27, 1964	Alaska	8.6
Sept. 19-20, 1985	Mexico City	8.1
Dec. 7, 1988	Armenia	6.9
Oct. 17, 1989	San Francisco	7.1
June 28,1992	Yucca Valley, CA	7.4

SOURCES: Johnson, O. (1992) and Liepold, M.L. (1988)

EARTHQUAKES PER YEAR WORLDWIDE

MAGNITUDE ON RICHTER SCALE	NUMBER PER YEAR
2.0-3.4	over 150,000
3.5-4.2	30,000
4.3-4.8	4,800
4.9-5.4	1,400
5.5-6.1	500
6.2-6.9	100
7.0-7.3	15
7.4-7.9	4
8.0-8.7	infrequent
9.0 and higher	never recorded

SOURCE: Johnson, O. (1992)

Seismograms show the *magnitude* of an earthquake. Magnitude is the amount of energy released by the earthquake. The higher the amplitude of the wave tracings, the greater the magnitude, the stronger the quake.

In order to talk about the magnitude of an earthquake, we use what is called the Richter scale. The Richter scale assigns numbers to earthquakes according to the amplitude to their waves. The greater the magnitude, the larger the Richter number. An increase on the Richter scale by just one number means the amount of energy released by the quake is 30 times greater. An earthquake that measures 7 on the Richter scale is 30 times as strong as a quake that measure 6.

APPLICATION

Review the Mercalli scale and intensity as a measure of earthquakes. Have students compare intensity with magnitude. Compare the Mercalli scale to the Richter scale by reviewing where students placed past earthquakes on the Mercalli scale with the actual magnitude of the quakes as measured on the Richter scale.

Discuss discrepancies between the two scales by having students identify why some quakes with greater magnitude had less intensity while other quakes with less magnitude had greater intensity. Discuss what, if anything, might have been done that would have affected the intensity of the quakes and lessened damage and loss of life.

Ask students to identify how the study of magnitude can impact the intensity of earthquakes. Using information on past earthquakes and where they have occurred, have students propose possible building regulations they would implement to lessen the intensity of quakes. Have students identify what building regulations might be necessary for the area in which they live considering the possibility of earthquakes and their potential magnitude.

CONCLUSION

The study of earthquakes can reveal much about the age, history and future evolution of the Earth, but the pragmatic side is how they affect people. For students who may see life as beyond their control, the greater lesson here is, even in this most uncontrollable of circumstances, there are aspects that when addressed can positively impact the situation.

REFERENCES

Johnson, O. (Ed.). (1992). Information please almanac, atlas and yearbook. Boston, Houghton Mifflin Company.

Liepold, M.L. (Ed.). (1988). Earthquakes: A teacher's package for K-6. Washington, D.C.: National Science Teachers Association.

SHOULD WE EXPLORE OUR SOLAR SYSTEM?

(Grades 5-8)

By Rhonda Gross

INTRODUCTION

Do you remember where you were when man first landed on the moon? Most people over the age of thirty can give very descriptive details as to their exact location and emotions during that historic event, whereas the children in today's classrooms weren't even born yet! This fact makes instruction concerning astronomy, space exploration, and colonization a difficult task for the classroom teacher.

Many educators want to convey to their students the awe and inspiration that space exploration created for the U.S. population during the 60's. Today's youths are not impressed with the space achievements of the past because the technology in their toys is more advanced than some early satellite designs. Modern science fiction movies are more exciting and visual than a man landing on the moon.

There is a new found accountability concerning space exploration that must now be addressed, and a need to evaluate the societal impact along with learning about our universe. Students must first be given an opportunity to explore their beliefs concerning the need for space exploration as compared to the other societal demands already present on this planet.

Objectives:

Students will . . .

1. Evaluate the cost of space exploration in relationship to the yearly national budget.
2. Brainstorm the benefits of space exploration.
3. Achieve a classwide consensus concerning the importance of space exploration compared with other societal needs.

Materials needed:

(a) Official looking blank checks-20 for each group of 4 students
(b) Tang® breakfast drink
(c) Freeze-dried astronaut ice cream (can be found in hiking equipment stores)
(d) Digital watch or other microchip technology
(e) Large paper-2 for each group
(f) Marking Pens

Procedure:

Pass out a small bite of the astronaut ice cream for the students to taste. Ask the students if they know why freeze-dried ice cream was invented. Spend a few moments discussing other astronaut foods such as Tang®. Point out items in the classroom whose development was influenced by space exploration, such as: calculators, digital watches, or the class computer.

EXPLORATION

Divide the class into groups of three or four students. Give each a group a large piece of paper and assign one student in the group to be the recorder. Instruct the students to list all of the things that they can think of that are budgeted and spent by our national government. To get the groups started, the whole class might be asked to give a few examples such as: Social Security, defense, welfare, or emergency relief. Set a 5 or 10 minute time limit on this activity.

EXPRESSION

After the time limit has expired, ask one of the students from each group to briefly explain their list. Allow each group to delete or add to their lists so that they each have about 20 items. Ask the recorder to write the title "U.S. Government Budget for 1993" or current year at the top of their list, and then write one trillion dollars underneath. Also be sure that NASA is included in each group's list.

Pass out 20 blank checks to each group and give the following instructions. "Your group is the finance committee of the House of Representatives, and you need to write out the checks for all of the items on your budget. First, you must decide what percentage of the one trillion dollars each item will get, and each item must receive some money".

You may need to briefly discuss how to correctly write a check, or show how many billions or millions there are in a trillion dollars. Every member of the group must agree on the amounts for each item and write out some of the checks. Ask the recorder to also write the amounts of the checks next to the items on the original budget paper.

After each group has completed check writing have a representative from each group present to the class their group consensus of the U.S. budget. Have them use their large budget paper in their presentation. It is easier for the class to see than small checks. Encourage discussion and justification concerning money spent on items in each of the budgets. Instruct each group to brainstorm any potential benefits from space exploration, writing down their thoughts on another large piece of paper. Remind them to include historical and predicted future benefits. Some suggested benefits might be personal computers, foods, weapons, robotics, or career opportunities.

LABELING

Display each group's budget and benefits of space exploration. Write the actual figures for the current U.S. budget on the blackboard using percentages. Some of the major items for 1991 are as follows:

National Defense	24.75%
International Affairs	.41%
Energy	.27%
Income Security (Unemployment insurance)	12.25%
Federal Employee Retirement	4.36%
Health Care	9.00%
Social Security	20.76%
Medicare	8.00%
Veteran's Benefits	2.41%
Social Services	3.15%
Education (Elementary-College)	.85%
Commerce and housing	1.90%
Transportation	2.45%
Natural resources and environment	1.46%
General Government	2.00%
Administration of Justice	1.75%
General Sciences	1.18%
NASA	.57%
Net interest	14.67%

Emphasize that NASA receives only .57% of the yearly budget.

SOURCE: Statistical abstract of the United States: 1991.

APPLICATION

Conduct a classwide discussion concerning each group's budgets, the benefits of space exploration, and the actual budgeted amount for NASA. Identify the varying views of individual members or groups within the classroom.

After the lesson it is important to encourage student action. Like-minded individuals may want to form new groups and pursue some of the following suggestions. Interview scientists working in the field of astronomy and ask their opinion concerning the national budget and NASA. Propose some alternative sources of income for NASA from the private sector. Research the privately funded Biosphere II program in Oracle, Arizona, to find out how they solicit money for future space exploration research.

Investigate the impact that space exploration has had on careers or local economy. Predict what future skills might be necessary to function within a space-exploration-centered society.

REFERENCES

U.S. Bureau of the Census. (1991). Statistical abstract of the United States: 1991.Washington, D.C.: Author.

SO WHAT'S THE DIRT ON THE STATES?

(Grades 5-8)

By Rhonda Gross

(With special thanks to Ginni Pettigrew who teaches junior high science in the Alhambra School District)

INTRODUCTION

A fun way to integrate language arts, social studies and science is through a research unit on the soils found in the 50 States. Friendly and business letter writing, oral presentations, survey of state environmental legislation, and soil investigation can all be incorporated under this one central theme.

Objectives:

Students will . . .

1. Write friendly letters using the correct format.
2. Write formal business letters.
3. Present a written or oral report to the class.
4. Participate in a simulated "town hall meeting" concerning state environmental issues.
5. Classify and investigate soil samples from all over the country.

ACTIVITY ONE

Assign a state to each member of the class. The state should have a relative or friend living in it who is known by someone in the class or school. This state will become that student's special state for the entire length of this unit. Set up a bulletin board with a large map of the United States and put the class member's name on their special state.

Practice the correct form of friendly letter writing by asking the students to write to a friend or relative in each assigned state and requesting him or her to send the class a small (about 2 teaspoonsful) soil sample from their area. Have the students enclose a self addressed, stamped envelope with the school address. Since this is a class assignment, most schools will allow your class to send the letters through the school office and will pay the postage.

Many of the receivers of the friendly letters will go all out and send special soil samples that they have collected, such as Georgian red soil, Hawaiian lava soil, or Alaskan glacier soil. When the soil samples begin arriving they should be put in clear plastic Ziplock® bags, marked by state and class member, and stapled onto the United States map on the bulletin board. The students will be amazed at the variety of colors and soil textures found in different parts of their country.

ACTIVITY TWO

Each student will write three business letters, using the correct format, to three different agencies in their special state. Have them pick any of the following: State Department of Tourism, Department of Wildlife or Game and Fish, State Legislative Committee on Environmental Issues, State Governor's Office Concerning Environmental Issues, State Soil Conservation Department, or some other agency in which they may have an interest. The requested information should be sent to the school address, and not to the student's home address.Address the envelopes to the department or agency, and send them to the capital of each state. The local post office has a zip code book in which you can look up the zip codes for every state capital. Ask two or three students to take the class list of states to the post office to find the needed zip codes. I have found that most students will receive two responses for every three that they send out. Students love to get mail and your class will be overwhelmed with posters, brochures, and plastic souvenirs from all over the country. School secretaries may need to be warned of the forthcoming mountain of mail.

ACTIVITY THREE

Now that your students have collected all this information, put it to good use. Assign projects to students such as a formal report on their special state, or an oral report. Students enjoy making posters using pictures and information from the mail they received and giving an oral presentation. Some students might want to do a special state dance such as the Hawaiian Hula, cook samples of a special food such as Texas chili, play the music for a state song, or show a video from the library about their state.

Encourage them to be as creative as they want to be.

ACTIVITY FOUR

Time to collect some more dirt! But this time each student must do research to find out some environmental "dirt" about their state. In other words, they have to identify an environmental problem in their state. The Alaskan oil spill, nuclear testing in Utah, and acid rain in Maine are just a few examples. They must also find something good that their state is doing for the environment such as mandatory recycling program or state supported wildlife refuges. Use several class periods to call a town meeting. At each meeting put three or four state representatives on the stand and ask them to defend their state's policies concerning the protection of the environment. This activity can lead to some very lively discussions and cause students to begin to formulate opinions on important conservation issues and problems.

ACTIVITY FIVE

Materials:

(a) Soil samples in Ziplock® baggies that have been numbered
(b) Hand lenses (one for every group of two students)

Procedure:

Divide the class into groups of two and pass out a hand lens, paper and a pencil. Give each group a soil sample and ask them to describe its visual properties on the paper. Tell them to carefully open the Ziplock® bag and smell the soil sample. They might want to taste a very small amount with the tip of their tongue, feel it, rub some of it between their thumb and finger while listening to the sound it makes, and use the hand lens to look at it more closely. They should record their experiences on their paper. Allow 5 minutes for the investigation of each soil sample, and then instruct all the groups to close the baggies and pass the soil sample to another group. Allow two class periods for the investigation of all the soil samples.

After all data has been recorded on paper, the students will use the information to classify the soil samples into various categories. A few possible ways to classify the soil are: by color, the saltiest tasting, the smelliest, most interesting sound, smooth or slippery, coarse or gritty or which contained the biggest pieces of materials. Have the students hypothesize as to where some of the soils might have come from. Salty, sandy soil from Florida was probably dug up near an ocean. Dark rich soil with pine needles might have come from a mountain forest.

SUGGESTED ADDITIONAL READING

Appel, G., Cadox, M. & et. al. (1982). The growing classroom: Book 2. Santa Cruz, CA: Project Life Lab.

STS GLOBAL AWARENESS - "THE GOOD LIFE" A CROSS CURRICULUM UNIT

(Grades 7-12)

By Teresa Olson

INTRODUCTION

One of the characteristics of STS instruction is student involvement through awareness of their individual and societal role in our global community. Science and social studies curriculum should provide opportunities for:

1. Development of the learner's understanding of themselves as interdependent members of society.
2. Recognizing society as a responsible agent of the ecosystem of nature.
3. Study and reflection
4. Decision making
5. Responsible action
6. Integration of specific subject matter to broader considerations of science, technology, and society.

I am proposing an educational strategy to introduce students to STS instruction which incorporates these goals. This unit is written for use in grades 7-12, but there is an adaptions section for those teachers of intermediate grades 4-6 who may wish to make use of parts of the unit.

DAY ONE

Students are asked to identify what would they need in order to have a good life? Time should be given for each student to think about and compose an answer to that question. After a short period of time, students who have completed an answer would be asked to read it aloud, with the suggestion to all students that they add any ideas they may hear from the others to their own answers. Students may at first tend to generalize in emotional or philosophical terms, and the teacher should gently remind them of some of their realistic needs such as clothing, education, books, and technological products such as electric light, television, and transportation. Students might be asked questions such as: Will you be satisfied to do without clothes washers or dryers? Are video games essential? Could we eliminate the NFL? How about shampoo and styling gel? How many new pairs of shoes a year would be ideal? What kind of a job will you need? How often should you shower? The students should be encouraged to think in terms of specific day to day needs, as well as greater needs such as love, safety, and friendship.

After the students have had adequate time to develop a comprehensive personal "wish list", the concept of society is explained to the students. Ask each student to write a short description of their own society, and exactly who belongs in it. Students will then be given the task of developing a "Good Life" statement to reflect their views concerning "What is needed for my society to incorporate a good life for all its members?" After a short work time, students should share their ideas with the rest of the class.The teacher should ask the question, "Are you finding any of your personal needs conflicting with the needs of your society?"

DAY TWO

The teacher begins with a recap of the previous day's comments and discussion. Then the teacher explains that today the focus will be on the needs for a good life in a global community. Classroom activity will begin with brainstorming what each part of the global community needs to have in place in order to ensure a "Good Life" for each of the global community's citizens.

Materials:

(a) One envelope per student containing their Global Community Membership Pass
(b) World Atlas
(c) Paper
(d) Pencil
(e) Copy of Information Organization Chart (If teacher desires)

Procedure:

Distribute one envelope to each student. Each student should get a Global Membership Pass from a different country. You may choose the completed passes provided in this article, or you may choose to have the students research the information. There are also Global Membership Pass blanks provided, should you prefer that instructional method.

This lesson would also function well as a kickoff unit for studying geography. A copy of a current world map which the students could flag with a locator pin as they read their country's data would be extremely useful. I suggest using a world map which gives a realistic portrayal of actual land mass size rather than focusing on the shape of the continents.

Each student reports his or her country membership information to some form of central recording device, such as a wall chart, information on the chalkboard, or a chart on the overhead projector. I have included an "Information Organization Chart" which may be made into an overhead transparency, or copied, so that each student can record the data.

CROSS-CURRICULUM CONCEPTS

MATH EXTENSIONS

Concept of Per Capita will need to be explained.

Concept of Percent was intentionally presented in two forms within the Global Community Membership passes. (# out of 100 and __%) After a brief explanation, and multiple readings of the passes, the students will become weary of the more cumbersome form, and of their own accord, switch naturally to using percentages. A good extension activity would be to have students transfer the infant mortality numbers over to percentages.

Concept of Population Density is represented in these passes as the average amount of people living per square mile, as repetitive definitions are useful in the retention of advanced concepts, but the educational goal is to teach the students the phrase population density.

Concept of Area will need to be in place for students to appreciate the area figures reported.

Graphs of many types could easily be produced by the students using the data presented in the passes.

LANGUAGE ARTS EXTENSIONS

Fact and Opinion: See worksheet included after membership passes. You may wish to furnish class copies of each of the Global Membership Passes referred to in this worksheet.

Answer Key: 1) F 2) F 3) O 4) O 5) F 6) O 7) F 8) O 9) F
10) F 11) O 12) F 13) F 14) O 15) O

Remember that even if an opinion is based on strong evidence, it is still only an opinion.

Vocabulary: See list included after membership passes.

Summaries of what they learned.

Further research can be done using the data. For example:

In Afghanistan, about 26 people out of 100 can read and write. Do you think that means 26% of both men and women can read and write? (The actual figures are; 14% of the women can; and 44% of the men can.) Ask your students to write out a possible explanation for this disparity. Population density may also be studied from the viewpoint of arable land available. For example, the reported population density of Egypt is 141 people per square mile, but considering the small amount of habitable land, the actual living density would be much higher. What does that mean in terms of the actual lifestyle of Egypt's citizens. There are well written books and articles available to answer these questions that would well serve as reading instruction materials. The class may pursue further research on many of the statistics.

SOCIAL STUDIES EXTENSIONS

Geography Kickoff: This unit design would function well as a lead in to the study of geography . It would help the students become aware of the areas of deficit in their concepts of global geography.

Map making: This data is particularly adaptable to the classroom construction of demographic maps. If needed, most of the information can be located for almost all of the world's countries.

Multicultural Education: This unit could be a starting point for intensive cultural exploration. Students could work individually, or in cooperative learning groups, to build in-depth informative portraits of entire continents, or cultures. I suggest starting with thought provoking questions such as "Why, do you think, there is such a difference in fertility rates from country to country? How do education, religion, economics, and nutrition relate to this? How do people live on $220 a year? How does the environment impact all of this?

Demographics: If the students become curious about an aspect of human existence not covered by this data, make it a research assignment for all or some of them.

TECHNOLOGY EXTENSIONS

Try to elicit statements from students giving the reasons that the United States uses such a large share of the world's energy. Ask them to predict what percentage of the world's pollution we create. Then have them research the answer.

After the students have become aware of some of the problems and inadequacies facing our global community, set up some type of problem solving experience to have them develop solutions for dealing with them. Organize an invention-sharing activity. Ask each student to commit to some form of action plan.

ADAPTING TO A YOUNGER AGE GROUP

Much of this data is too complex for the younger student. They will be able to understand it if suitable adaptions are made. Here are some suggestions:

Some of the pieces of data could be blacked out on the Global Community Membership Passes, to simplify the task.

Before students begin sharing the information on the passes, have them write down the name and age of someone they know who is a senior citizen, like a grandparent or a school volunteer. As you read through the life expectancy figures, ask a question such as, "How many of your special older persons would probably still be living if they had been born in Cambodia?" Students tend to visualize even a young age such as 20 years as being so far away that they'll never reach it, but this would put the statistics into a form with more personal meaning.

Translate infant mortality statistics into a more comprehensible form, such as, "How many students in this school would not have lived through their first year in Angola?"

Concentrate on one piece of the puzzle at a time. If you decide to use only the statistics on population and energy use, have the population figures for each country reported first, and then start on the remaining statistics.

STATEMENT REGARDING THE GLOBAL MEMBERSHIP PASSES

These passes were designed to reflect some of the disparities and injustices prevalent in the lifestyles of many members of our global community due to a disproportionate and wasteful use of the world's resources. They were in no way meant to be a condemnation of any of the word's peoples, religions, or cultures.

It was not economically feasible to prepare a Global Community Membership Pass for each of the world's nations. The countries that were chosen represent the major geographical areas of the world. Blank forms are provided for instructors or students who wish to include one or more of the nations not mentioned in this article.

GLOBAL COMMUNITY MEMBERSHIP PASSES:

I am a citizen of the United States. I will live to be, on the average, about 76 years old. For every 1000 babies born in my country each year, about 10 of them die in their first year. About 250 million people live in my country. It has about 3.6 million square miles, making the average amount of people living per square mile about 69. An average group of 100 women in my country will have 185 babies during their lives. By the year 2010, we will have 283 million people. We have about 5 % of the world's population, and we use about 24% of the world's energy. 97 out of every 100 citizens over 15 years old can read and write. Average per capita income is $19,620

I am a citizen of Afghanistan. I will live to be, on the average, about 47 years old. For every 1000 babies born in my country each year, about 154 of them die in their first year. About 16 million people live in my country. Its area is about 250 thousand square miles, making the average amount of people living per square mile about 63. An average group of 100 women in my country will have 640 babies during their lives. By the year 2010, we will have 34 million people. We have about .3 of 1% of the world's population, and we use about .04 of 1% of the world's energy. 29 out of every 100 citizens over 15 years of age can read and write. Average per capita income figures not available, as economy is not really based on currency.

I am a citizen of Angola. I will live to be, on the average, about 44 years old. For every 1000 babies born in my country each year, about 158 of them die in their first year. About 8.5 million people live in my country. Its area is about 480 thousand square miles, making the average amount of people living per square mile about 18. An average group of 100 women in my country will have 672 babies during their lives. By the year 2010, we will have 14.4 million people. We have about .2 of 1% of the world's population, and we use .02 of 1% of the world's energy. 42 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $220.

I am a citizen of Argentina. I will live to be, on the average, about 71 years old. For every 1000 babies born in my country each year, about 32 of them die in their first year. About 32 million people live in my country. Its area is about 1 million square miles, making the average amount of people living per square mile about 30. An average group of 100 women in my country will have 277 babies during their lives. By the year 2010, we will have 40 million people. We have about .5 of 1% of the world's population, and we use .6 of 1% of the world's energy. 95 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $2180.

I am a citizen of Australia. I will live to be, on the average, about 77 years old. For every 1000 babies born in my country each year, about 8 of them die in their first year. About 17 million people live in my country. Its area is about 3 million square miles, making the average amount of people living per square mile about 6. An average group of 100 women in my country will have 184 babies during their lives. By the year 2010, we will have 21 million people. We have about .3 of 1% of the world's population, and we use 1% of the world's energy. 100 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $14,270.

I am a citizen of Bangladesh. I will live to be, on the average, about 54 years old. For every 1000 babies born in my country each year, about 136 of them die in their first year. About 118 million people live in my country. Its area is about 56 thousand square miles, making the average amount of people living per square mile about 2130. An average group of 100 women in my country will have 572 babies during their lives. By the year 2010, we will have 192 million people. We have about 2% of the world's population, and we use .1 of 1% of the world's energy. 35 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $170.

I am a citizen of Brazil. I will live to be, on the average, about 65 years old. For every 1000 babies born in my country each year, about 69 of them die in their first year. About 153 million people live in my country. Its area is about 3 million square miles, making the average amount of people living per square mile about 46. An average group of 100 women in my country will have 313 babies during their lives. By the year 2010, we will have 207 million people. We have about 3% of the world's population, and we use 2% of the world's energy. 81 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $1960.

I am a citizen of Cambodia. I will live to be, on the average, about 49 years old. For every 1000 babies born in my country each year, about 128 of them die in their first year. About 7 million people live in my country. Its area is about 70 thousand square miles, making the average amount of people living per square mile about 100. An average group of 100 women in my country will have 453 babies during their lives. By the year 2010, we will have 10 million people. We have about .1 of 1% of the world's population, and we use .01 of 1% of the world's energy. 35 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $300.

I am a citizen of Canada. I will live to be, on the average, about 77 years old. For every 1000 babies born in my country each year, about 7 of them die in their first year. About 27 million people live in my country. Its area is about 3.8 million square miles, making the average amount of people living per square mile about 7. An average group of 100 women in my country will have 167 babies during their lives. By the year 2010, we will have 31 million people. We have about .5 of 1% of the world's population, and we use 3% of the world's energy. 99 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $18,920.

I am a citizen of Chile. I will live to be, on the average, about 73 years old. For every 1000 babies born in my country each year, about 18 of them die in their first year. About 13 million people live in my country. Its area is about 300 thousand square miles, making the average amount of people living per square mile about 45. An average group of 100 women in my country will have 251 babies during their lives. By the year 2010, we will have 17 million people. We have about .2 of 1% of the world's population, and we use .2 of 1% of the world's energy. 93 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $1800.

I am a citizen of mainland China. I will live to be, on the average, about 68 years old. For every 1000 babies born in my country each year, about 34 of them die in their first year. About 1.1 billion people live in my country. Its area is about 3.7 million square miles, making the average amount of people living per square mile about 302. An average group of 100 women in my country will have 228 babies during their lives. By the year 2010, we will have 1.4 billion people. We have about 21% of the world's population, and we use about 9% of the world's energy. 73 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $320.

I am a citizen of Columbia. I will live to be, on the average, about 71 years old. For every 1000 babies born in my country each year, about 38 of them die in their first year. About 33 million people live in my country. Its area is about 440 thousand square miles, making the average amount of people living per square mile about 75. An average group of 100 women in my country will have 290 babies during their lives. By the year 2010, we will have 46 million people. We have about .6 of 1% of the world's population, and we use .3 of 1% of the world's energy. 87 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $1110.

I am a citizen of Czechoslovakia. I will live to be, on the average, about 73 years old. For every 1000 babies born in my country each year, about 11 of them die in their first year. About 16 million people live in my country. Its area is about 49 thousand square miles, making the average amount of people living per square mile about 318. An average group of 100 women in my country will have 197 babies during their lives. By the year 2010, we will have 17 million people. We have about .3 of 1% of the world's population, and we use .9 of 1% of the world's energy. 99 out of every 100 citizens over 15 years of age can read and write. Average per capita income is not available.

I am a citizen of Denmark. I will live to be, on the average, about 76 years old. For every 1000 babies born in my country each year, about 6 of them die in their first year. About 5 million people live in my country. Its area is about 17 thousand square miles, making the average amount of people living per square mile about 309. An average group of 100 women in my country will have 156 babies during their lives. By the year 2010, we will have 5 million people. We have about .09 of 1% of the world's population, and we use .2 of 1% of the world's energy. 99 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $17,877.

I am a citizen of Ecuador. I will live to be, on the average, about 66 years old. For every 1000 babies born in my country each year, about 61 of them die in their first year. About 10.5 million people live in my country. Its area is about 109 thousand square miles, making the average amount of people living per square mile about 96. An average group of 100 women in my country will have 379 babies during their lives. By the year 2010, we will have 15.5 million people. We have about .2 of 1% of the world's population, and we use .08 of 1% of the world's energy. 86 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $1080.

I am a citizen of Egypt. I will live to be, on the average, about 60 years old. For every 1000 babies born in my country each year, about 90 of them die in their first year. About 55 million people live in my country. Its area is about 390 thousand square miles, making the average amount of people living per square mile about 141. An average group of 100 women in my country will have 468 babies during their lives. By the year 2010, we will have 85 million people. We have about 1% of the world's population, and we use .4 of 1% of the world's energy. 48 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $640.

I am a citizen of El Salvador. I will live to be, on the average, about 65 years of age. For every 1000 babies born in my country each year, about 49 of them die in their first year. About 5 million people live in my country. Its area is about 8 thousand square miles making the average amount of people living per square mile about 654. An average group of 100 women in my country will have 414 babies during their lives. By the year 2010, we will have 7.6 million people. We have about .09 of 1% of the world's population, and we use .02 of 1% of the world's energy. 73 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $930.

I am a citizen of Ethiopia. I will live to be, on the average, about 51 years of age. For every 1000 babies born in my country each year, about 116 of them die in their first year. About 52 million people live in my country. Its area is about 472 thousand square miles, making the average amount of people living per square mile about 110. An average group of 100 women in my country will have 703 babies during their lives. By the year 2010, we will have 95 million people. We have about 1% of the world's population, and we use .07 of 1% of the world's energy. 62 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $260.

I am a citizen of France. I will live to be, on the average, about 78 years of age. For every 1000 babies born in my country each year, about 6 of them die in their first year. About 56 million people live in my country. Its area is about 211 thousand square miles, making the average amount of people living per square mile about 267. An average group of 100 women in my country will have 182 babies during their lives. By the year 2010, we will have 60 million people. We have about 1% of the world's population, and we use 2% of the world's energy. 99 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $15,920.

I am a citizen of Germany. I will live to be, on the average, about 76 years old. For every 1000 babies born in my country each year, about 7 of them will die in their first year. About 78 million people live in my country. Its area is about 138 thousand square miles, making the average amount of people living per square mile about 570. An average group of 100 women in my country will have 144 babies during their lives. By the year 2010, we will have 79 million people. We have about 1.5% of the world's population, and we use 2% of the world's energy. 99 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $18,740.

I am a citizen of Greece. I will live to be, on the average, about 78 years of age. For every 1000 babies born in my country each year, about 10 of them will die in their first year. About 10 million people live in my country. Its area is about 51 thousand square miles, making the average amount of people living per square mile about 197. An average group of 100 women in my country will have 154 babies during their lives. In the year 2010, we will still have 10 million people. We have about .2 of 1% of the world's population, and we use .3 of 1% of the world's energy. 93 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $5000.

I am a citizen of Guinea. I will live to be, on the average, about 42 years of age. For every 1000 babies born in my country each year, about 147 of them will die in their first year. About 7 million people live in my country. Its area is about 95 thousand square miles, making the average amount of people living per square mile about 77. An average group of 100 women in my country will have 607 babies during their lives. By the year 2010, we will have 11.5 million people. We have about .1 of 1% of the world's population, and we use .01 of 1% of the world's energy. 24 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $200.

I am a citizen of Haiti. I will live to be, on the average, about 53 years of age. For every 1000 babies born in my country each year, about 107 of them will die in their first year. About 6 million people live in my country. Its area is about 11 thousand square miles, making the average amount of people living per square mile about 573. An average group of 100 women in my country will have 640 babies during their lives. By the year 2010, we will have 9 million people. We have about .1 of 1% of the world's population, and we use .01 of 1% of the world's energy. 53 out of every 100 citizens over 15 years of age can read and write. Average per capita income is not available.

I am a citizen of India. I will live to be, on the average, about 58 years of age. For every 1000 babies born in my country each year, about 89 of them will die in their first year. About 850 million people live in my country. Its area is about 1.3 million square miles, making the average amount of people living per square mile about 669. An average group of 100 women in my country will have 378 babies during their lives. By the year 2010, we will have almost 1.2 billion people. We have about 16% of the world's population, and we use 3% of the world's energy. 48 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $360.

I am a citizen of Iran. I will live to be, on the average, about 63 years of age. For every 1000 babies born in my country each year, about 91 of them will die in their first year. About 56 million people live in my country. Its area is about 640 thousand square miles, making the average amount of people living per square mile about 87. Am average group of 100 women in my country will have 632 babies during their lives. By the year 2010, we will have 101 million people. We have about 1% of the world's population, and we use .8 of 1% of the world's energy. 54 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $3100.

I am a citizen of Iraq. I will live to be, on the average, about 67 years of age. For every 1000 babies born in my country each year, about 67 of them will die in their first year. About 19 million people live in my country. Its area is about 168 thousand square miles, making the average amount of people living per square mile about 112. An average group of 100 women in my country will have 731 babies during their lives. By the year 2010, we will have 38 million people. We have about .3 of 1% of the world's population, and we use .2 of 1% of the world's energy. 60 out of every 100 citizens over 15 years of age can read and write. Average per capita income is not available.

I am a citizen of Japan. I will live to be, on the average, about 79 years of age. For every 1000 babies born in my country each year, about 5 of them will die in their first year. About 124 million people live in my country. Its area is about 144 thousand square miles, making the average amount of people living per square mile about 860. An average group of 100 women in my country will have 161 babies during their lives. By the year 2010, we will have 128 million people. We have about 2% of the world's population, and we use 5% of the world's energy. 99 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $22,000.

I am a citizen of Madagascar. I will live to be, on the average, about 52 years of age. For every 1000 babies born in my country each year, about 97 of them will die in their first year. About 12 million people live in my country. Its area is about 229 thousand square miles, making the average amount of people living per square mile about 52. An average group of 100 women in my country will have 694 babies during their lives. By the year 2010, we will have 22 million people. We have about .2 of 1% of the world's population, and we use .02 of 1% of the world's energy. 80 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $230.

I am a citizen of Malawi. I will live to be, on the average, about 49 years old. For every 1000 babies born in my country each year, about 130 of them will die in their first year. About 9 million people live in my country. Its area is about 46 thousand square miles, making the average amount of people living per square mile about 200. An average group of 100 women in my country will have 768 babies during their lives. By the year 2010, we will have 16 million people. We have about .2 of 1% of the world's population, and we use .02 of 1% of the world's energy. 22 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $150.

I am a citizen of Malaysia. I will live to be, on the average, about 68 years old. For every 1000 babies born in my country each year, about 30 of them will die in their first year. About 18 million people live in my country. Its area is about 128 thousand square miles, making the average amount of people living per square mile about 136. An average group of 100 women in my country will have 351 babies during their lives. By the year 2010, we will have 26 million people. We have about .3 of 1% of the world's population, and we use .2 of 1% of the world's energy. 78 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $2,3000.

I am a citizen of Mexico. I will live to be, on the average, about 72 years old. For every 1000 babies born in my country each year, about 33 of them will die in their first year. About 88 million people live in my country. Its area is about 760 thousand square miles, making the average amount of people living per square mile about 115. An average group of 100 women in my country will have 343 babies during their lives. By the year 2010, we will have 129 million people. We have about 2% of the world's population, and we use 1% of the world's energy. 87 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $2,360.

I am a citizen of Mozambique. I will live to be, on the average, about 47 years old. For every 1000 babies born in my country each year, about 138 of them will die in their first year. About 15 million people live in my country. Its area is about 300 thousand square miles, making the average amount of people living per square mile about 48. An average group of 100 women in my country will have 649 babies during their lives. By the year 2010, we will have 24 million people. We have about .3 of 1% of the world's population, and we use .03 of 1% of the world's energy. 33 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $90.

I am a citizen of the Philippines. I will live to be, on the average, about 66 years old. For every 1000 babies born in my country each year, about 48 of them will die in their first year. About 66 million people live in my country. Its area is about 116 thousand square miles, making the average amount of people living per square mile about 570. An average group of 100 women in my country will have 426 babies during their lives. By the year 2010, we will have 100 million people. We have about 1% of the world's population, and we use .2 of 1% of the world's energy. 90 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $670.

I am a citizen of Saudi Arabia. I will live to be, on the average, about 65 years old. For every 1000 babies born in my country each year, about 71 of them will die in their first year. About 17 million people live in my country. Its area is about 830 thousand square miles, making the average amount of people living per square mile about 21. An average group of 100 women in my country will have 676 babies during their lives. By the year 2010, we will have 34 million people. We have about .3 of 1% of the world's population, and we use .8 of 1% of the world's energy. 62 out of every 100 citizens over 15 years of age can read and write. Average per capita income is not available.

I am a citizen of South Africa. I will live to be, on the average, about 64 years old. For every 1000 babies born in my country each year, about 52 of them will die in their first year. About 40 million people live in my country. Its area is about 470 thousand square miles, making the average amount of people living per square mile about 84. An average group of 100 women in my country will have 450 babies during their lives. By the year 2010, we will have 66 million people. We have about .8 of 1% of the world's population, and we use 1% of the world's energy. 76 out of every 100 citizens over 15 years of age can read and write. Average per capita income is $1,807.

I am a citizen of the former Soviet Union. I will live to be, on the average, about 70 years old. For every 1000 babies born in my country each year, about 24 of them will die in their first year. About 291 million people live in my country. Its area is about 8.6 million square miles, making the average amount of people living per square mile about 34. An average group of 100 women in my country will have 239 babies during their lives. By the year 2010, we will have 334 million people. We have about 5% of the world's population, and we use 18% of the world's energy. 98 out of every 100 citizens over 15 years of age can read and write. Average per capita income is not available.

I am a citizen of Uganda. I will live to be, on the average, about 49 years old. For every 1000 babies born in my country each year, about 107 of them will die in their first year. About 18 million people live in my country. Its area is about 91 thousand square miles, making the average amount of people living per square mile about 197. An average group of 100 women in my country will have 735 babies during their lives. By the year 2010, we will have 33 million people. We have about .3 of 1% of the world's population, and we use .2 of 1% of the world's energy. 48 out of every 100 citizens over 15 years of age can read and write. Average per capita income is not available.

I am a citizen of the United Kingdom. I will live to be, on the average, about 76 years old. For every 1000 babies born in my country each year, about 7 of them will die in their first year. About 57 million people live in my country. Its area is about 94 thousand square miles, making the average amount of people living per square mile about 609. An average group of 100 women in my country will have 182 babies during their lives. By the year 2010, we will have 59 million people. We have about 1% of the world's population, and we use 3% of the world's energy. 99 out of every 100 citizens over 15 years of age can read and write. Average per capita income is approximately $12,600.

I am a citizen of Vietnam. I will live to be, on the average, about 64 years old. For every 1000 babies born in my country each year, about 50 of them will die in their first year. About 66 million people live in my country. Its area is about 127 thousand square miles, making the average amount of people living per square mile about 520. An average group of 100 women in my country will have 381 babies during their lives. By the year 2010, we will have 92 million people. We have about 1% of the world's population, and we use .1 of 1% of the world's energy. 88 out of every 100 citizens over 15 years of age can read and write. Average per capita income is approximately $300.

I am a citizen of Yemen. I will live to be, on the average, about 50 years old. For every 1000 babies born in my country each year, about 124 of them will die in their first year. About 9.7 million people live in my country. Its area is about 200 thousand square miles, making the average amount of people living per square mile about 49. An average group of 100 women in my country will have 746 babies during their lives. By the year 2010, we will have 19 million people. We have about .2 of 1% of the world's population, and we use .01 of 1% of the world's energy. 38 out of every 100 citizens over 15 years of age can read and write. Average per capita income is not available.

I am a citizen of ________________________. I will live to be, on the average, about _________ years old. For every 1000 babies born in my country each year, about ______ of them die in their first year. About ___________________________ people live in my country. Its area is _______________________ square miles, making the average amount of people living per square mile about ____________. An average group of 100 women in my country will have __________ babies during their lives. By the year 2010, we will have _________ million people. We have about __________________ % of the world's population, and we use about __________________ % of the world's energy. ______ out of every 100 citizens over 15 years of age can read and write. Average per capita income is $________________.

I am a citizen of ________________________. I will live to be, on the average, about _________ years old. For every 1000 babies born in my country each year, about ______ of them die in their first year. About ___________________________ people live in my country. Its area is _______________________ square miles, making the average amount of people living per square mile about ____________. An average group of 100 women in my country will have __________ babies during their lives. By the year 2010, we will have _________ million people. We have about __________________ % of the world's population, and we use about __________________ % of the world's energy. ______ out of every 100 citizens over 15 years of age can read and write. Average per capita income is $________________.

I am a citizen of ________________________. I will live to be, on the average, about _________ years old. For every 1000 babies born in my country each year, about ______ of them die in their first year. About ___________________________ people live in my country. Its area is _______________________ square miles, making the average amount of people living per square mile about ____________. An average group of 100 women in my country will have __________ babies during their lives. By the year 2010, we will have _________ million people. We have about __________________ % of the world's population, and we use about __________________ % of the world's energy. ______ out of every 100 citizens over 15 years of age can read and write. Average per capita income is $________________.

I am a citizen of ________________________. I will live to be, on the average, about _________ years old. For every 1000 babies born in my country each year, about ______ of them die in their first year. About ___________________________ people live in my country. Its area is _______________________ square miles, making the average amount of people living per square mile about ____________. An average group of 100 women in my country will have __________ babies during their lives. By the year 2010, we will have _________ million people. We have about __________________ % of the world's population, and we use about __________________ % of the world's energy. ______ out of every 100 citizens over 15 years of age can read and write. Average per capita income is $________________.

VOCABULARY LIST

Define in your own words:

Demographics:

Fertility Rate:

Global Community:

Infant Mortality:

Life Expectancy:

Literacy Rate:

Per Capita:

Per Capita Income:

Percent:

Population Density:

Projected Statistics:

Society:

FACT AND OPINION - GLOBAL COMMUNITY

TEACHER: ______________________

STUDENT: ______________________

ANSWER THE FOLLOWING WITH THE WORD "FACT" OR THE WORD "OPINION"

1 ________ There are about 250 million people living in the U.S. now.

2. ________ People in Brazil make more money than people in Bangladesh.

3. ________ The United States is the best country to live in.

4. ________ Those women in Yemen better stop having so many babies.

5. ________ China has more people than any other country.

6. ________ Denmark and France have the best medical care because only 6 out of every 1000 babies born there every year die.

7. ________ There are more people living per square mile in Germany than in the United States.

8. ________ People in the U.S. are smarter than people in Egypt, because more people here (per 100) can read and write.

9. ________ People in the U.S. use more power per person than any other country in the world.

10. ________ A lot of people in Angola do not have very much money.

11 ________ Americans are selfish and wasteful, and that's why they use so much of the world's energy.

12. ________ Women in the poorer less developed countries tend to have more babies than in the richer more industrialized countries.

13. ________ Ethiopia is bigger than France.

14. ________ People don't live as long in Guinea because they are poor.

15. ________ The people in the United States need to use less energy.

16. ________ The people in Iran need better schools.

INFORMATION ORGANIZING CHART - WORLD FACTS

L.E.=Life Expectancy
In. M.=Infant Mortality
P.D.=Population Density
Fer.=Fertility (Births per 100 women in their lifetimes)
%WP=Percent of the World's Population
%WE=Percent of World's Energy consumed
% Lit.=Literacy(Percent of citizens over 15 who can read and write)
P.C.I.=Per Capita Income

Country	L.E.	In. M	Population	Area	P.D.	Fer.	%WP	%WE	%Lit.	P. C. I.

SOURCES OF DATA

The data for this article were collected from various sources. Life Expectancy, Infant Mortality, Population, Area, Population Density, Fertility Rate, and population projections for the year 2010 were collected from:

U.S. Bureau of the Census. (1991). Statistical abstract of the United States: 1991. Washington, DC: Author.
Percentages of energy usage were calculated using statistics from:
World Resources Institute, United Nations Environment Programme. World Resources - A Report. New York: Oxford University Press.

The most recent available literacy estimates for the years 1980-1990 were collected from:

Central Intelligence Agency. (1991). World Fact Book. Washington, DC: Author.
Per capita income statistics were calculated using statistics from:
The World Bank. (1991) World Tables. Baltimore:The Johns Hopkins University Press.

Almanacs will provide much of this information, should you choose to let your students do additional research in the classroom. But be advised that the per capita financial figures most commonly reported in most sources are for per capita share of the Gross National or Gross Domestic Product, rather than Per Capita Income.

STS MEDIA SEARCH

(Grades 4-8)

By Teresa Olson

INTRODUCTION

A primary focus of STS instruction is to create a society more aware of its technological capabilities, responsibilities, and problems. The following activity can be used to introduce students to the tasks of gathereing and reviewing information.

The instructor functions as a facilitator and provides students the opportunity to select from various types of media. The primary focus of this lesson is exploration, and the students will choose the direction in which the lesson will progress.

Materials:

(a) Class sets of periodicals which will be cut up
(b) Non-consumable periodicals at various reading levels
(c) Index cards in 2 colors
(d) Several large pieces of chart paper
(e) Class set of markers
(f) Scissors
(g) Glue
(h) One folder or large manila envelope per group

PHASE ONE - LESSON INTRODUCTION

The instructor asks general questions such as "Are science and technology things we hear about or see only in school? Where else would we hear about them?" After eliciting student responses such as television, radio, the mall, in cars, newspapers, and magazines, the teacher will ask students to list products and issues related to science and technology that they might read about or see in daily life or in the media. If students are not already familiar with the concept of brainstorming, explain that for a set period of time, approximately five to ten minutes, the teacher will simply record all answers without judgment or comment. At the end of that time, there will be further teacher instruction regarding their answers. At the end of the brainstorming period, the teacher will discuss their suggestions, elaborating upon which ideas, issues, topics, and products are included within the general scope of science and technology. The most important concept to be related here is that it would be impossible to list everything in such a short period of time.

PHASE TWO - PROJECT DEVELOPMENT

The teacher should explain that the purpose of this lesson is twofold:

1. To introduce them to the concepts included in STS instruction
2. To help them to become familiar with various media.

The teacher should explain to students that they will have to continue to pursue knowledge if they are to become scientifically and technologically literate. Suggested guidelines for this assignment are geared for a sixth grade classroom.

Teacher cue:

"For the next few days you will be collecting as many articles in periodicals, with references to science and technology in our society, as you can find. Your grade will be based on how many references your group collects. The minimum amount that will be acceptable to earn a letter grade of a 'C' will be eight references. I have supplied you with two types of periodicals which are for your use, and you may cut them up as needed. I also have available for checkout many other magazines which must be returned to me in the same condition they were in when you borrowed them. You may use index cards to summarize any articles dealing with STS issues. Be sure to name the title, author and source of any summarized reference. You may also want to use the index cards to summarize an item you see on the news or on a television documentary. If your group wants to work for a higher grade than a 'C', be aware that you will need significantly more than 8-10 references to get a higher grade, and you must find at least 2 references outside this classroom, to achieve an 'A' rating."

> (**NOTE TO THE TEACHER**: I did not define the word 'significantly' in these grading standards, because I prefer to make that arrangement on an informal basis with individual students according to their ability levels.)

Next, the teacher should specify the amount of time that will be made available to do the work within the classroom. The teacher should also hand out one folder or large manila envelope per group, to hold their references. The teacher should circulate among the students in order to answer questions, and to reinforce the job assignment.

PHASE THREE - READING TO CRITIQUE

The teacher asks students if they have anything to report regarding their media search thus far. An effort should be made to positively reward those students finding references outside the classroom. Next, the teacher should ask a question such as, "Just because you see something in print or on the news, does that make it true? How do you decide what is true and what is not?" After a short discussion, the teacher should supply two articles centering on the same, preferably controversial, issue. These articles should differ in their presentation or interpretation of the issue.

After these article are read, students will respond to them on the basis of their perceived reliability. The teacher should probe for the reasons behind their judgments. At this time students will be introduced to methods for critical judgment of an author's work such as investigating an author's educational, professional, and political background. Students could read other pieces they have written, attempting to judge the bias of the author or the periodical from which the piece was taken. Compare materials written by other authors dealing with the same theme. At this point, you may decide to pursue any of these avenues as an additional classroom lesson.

Ask your students to evaluate each of the references they have collected on a 'perceived truth scale' of 1-10. The expectation is not for the students to be able to accurately judge the validity of the content of the text. The purpose is simply to ensure that they become aware of the need to be critical consumers of information provided by the various media.

PHASE FOUR - MEDIA SEARCH REFERENCES DUE

Students will bring all of their collected references into class. Within their groups, they will compare and eliminate all replications. They will sort their articles into categories, based on the perceived similarities in the topics of these articles. The teacher should not mention any specific categories at this time, since the students should attempt to develop their own schemes of classification.

After adequate time has been allowed, each group will report what choices they made for grouping their references. The teacher records each group's category choices for the entire class to see. After the final group reports, the following questions are asked, "How can we group all of the different types of information about science and technology in our society? What major groupings should we use?" With guidance, the students should come up with most of the major STS topic strands such as Energy, Robotics, Environment, Health and Bioengineering, and Computers. The teacher should then ask, "Did we cover all problem areas?" If the students are satisfied, even if there is a major area missing, the teacher may want to let them discover the need for additional categories as the year progresses.

After the category choices are made, the teacher should label a large piece of chart paper for each category. These should be tacked up on the walls. Instruct each group to determine a category which is most closely related to one of their articles. Students will then glue their references on the appropriate sheet. Have the students repeat this process for all of their articles, taking one article at a time. After the students complete their assignment, encourage them to bring in more references as they become aware of additional articles related to science and technology.

PHASE FIVE - STS IN OBJECTS OF DAILY USE

This lesson begins with a simple teacher query to students. "Now that you are getting a better idea of what STS is, are there any things in your life besides news stories that are examples of STS? What types of things, in your daily life, would you not have if there had never been science or technology?" After the students throw out enough ideas to assure comprehension of the query, the teacher asks students to work in groups. Each group should brainstorm examples and write each example on an index card.

After adequate time has been allowed to work on this task, the teacher asks students to organize the examples into broad categories, and report their categories to the whole class. Ask the students to sort the cards into two piles, identified as necessary or not necessary to the enjoyment of life. Stipulate that they can only have a set number of items, for example 5, and will then have to go through life without all the others. Now, sit back and watch the fur fly as they argue priorities. After a preset length of time, ask each group to make a short oral report on their group's progress at making these choices. I've included a short list of some technology ownership statistics at the end of this unit which may be of interest to you and your students.

Collect the index cards as you will need them for the next day's lesson. They also make an excellent wall display.

PHASE SIX - POSITIVE AND NEGATIVE EFFECTS OF TECHNOLOGY ON QUALITY OF LIFE.

The teacher chooses 3-5 technology-related topics that are suitable for his or her students. The topics should be high-tech, high-demand, and somehow include problematic aspects of technology such as pollution, expense, or high resource usage.

Teacher leads by stating, "Today we will examine the effects of technology in our daily life. We will use some of the examples you thought up yesterday. For example, how many of you listed automobiles? I'm going to list all the positive and negative effects of automobiles on our society that you can think of. Let's brainstorm as a group."

This process should be repeated with other examples of scientific or technological developments. Then ask each student to pick one example of technology and to list all the positive and negative aspects of which he or she can think. Be sure to provide your students many ideas from which to choose. Ask them to use their imagination to invent solutions to the problems.

You may wish, as an extension activity, to have the students do a library periodical search for the possible effects of some technology with a history of controversy. Such subject areas might include insecticides, infant formulas in the third world, nuclear power, or dry cleaning toxins. You may also wish to include an "imagine a solution" activity by either having them draw an invention, or plan a suggested method of improvement.

It is important to remember that just providing data about problems without enabling students to take action or become empowered in some way, can lead to apathy and depression among some students. I would strongly advise providing some opportunity for action, even if it's something as simple as writing letters to political figures or an in-class recycling effort. There are several good suggestions in this handbook, but the best thing to do is concentrate on the areas of concern that your students express.

TELEPHONES, NEWSPAPERS, TV SETS, AND RADIOS IN SELECTED COUNTRIES

Country	Telephones Per 1000	Newspaper Per 1000 *	TV. sets Per 1000	Radios Per 1000
United States	760	259	812	2,120
Bangladesh	1	7	4	41
Brazil	93	48	194	371
Canada	780	225	568	960
Mainland China	7	29	24	184
East Germany	233	585	759	669
Egypt	28	39	84	313
Ethiopia	3	1	2	193
France	608	193	399	895
Mexico	96	124	124	241
Nigeria	3	6	6	164
Philippines	15	56	37	135
United Kingdom	524	421	435	1146

*Daily newspapers circulated per 1000 people.

SOURCE OF THE DATA

U.S. Bureau of the Census. (1991). Statistical abstract of the United States-1991. Washington, DC: Author.

S.T.S. STAR BRIGHT

(Grades 6-12)

By Sandra Israel & Linda Begalman

TO THE TEACHER

The purpose of this lesson is to help students become better informed about the environmental problems that are facing the inhabitants of our planet. Many of these problems are global in nature. Their solutions will require a global effort.

The main activity in this lesson is an interactive skit, providing a "hands-on" approach regarding environmental issues. The setting for this skit is in the future, on a space ship heading towards an imaginary planet. The problems facing the inhabitants of this imaginary planet of "Terah" are analogous to many of the problems facing the inhabitants of our own planet Earth. It is the authors' hope that this abstract format will be appealing to students and allow them to formulate ideas for solutions without the interference of becoming too personally involved in the issues presented. We hope that this lesson will help them gain a better understanding of the complexities involved in identifying, evaluating, and solving problems that impact an entire planet.

> (**AUTHORS' NOTE**: It is not our intent to alarm students by presenting only the dark and gloomy side of the issues concerning our environment. Please make sure that students are aware that there are many groups and individuals who are working diligently to solve our environmental problems.)

Materials:

(a) Copies of the S.T.S. Star Bright skit
(b) Glossary
(c) Data Cards

Teaching Time:

- 3-5 forty-five minute periods

Objectives:

Students will be able to:

1. Classify data into appropriate categories.
2. Identify cause and effect relationships.
3. Recognize potential sources of problems.
4. Generate solutions to the identified problems.
5. Evaluate and prioritize the solutions.
6. Select the best solution and justify their selections.

Procedure:

1. Copy the data cards and cut them apart, making sure that the title at the top of each set (e.g.. Water) does not appear. Shuffle the cards to randomize their order.
2. Make 9 copies of the student script. One copy for the Captain Docent and each crew member.
3. Make copies of the Glossary, one for each student in the classroom.
4. Assign the parts of First Officer and crew member to students. (Remember, the teacher is Captain Docent). Allow these students sufficient time to read and practice their assigned parts before performing the skit.

LESSON # 1

Review of Vocabulary:

Some of the vocabulary used in the skit may be rather difficult for younger or lower achieving students. To help these students, a Glossary has been provided. The following activities are suggested to assure that all the students are familiar with the vocabulary and terminology used in the skit and data cards.

1. Hand out copies of the Glossary to the students.
2. Have the students read and study the Glossary; individually, in pairs, small groups, or as an entire class.
3. Choose an activity to evaluate the students' competency with the vocabulary.
    a) Have the students write sentences using the words in the glossary.
    b) Have the students match the words to the definitions. (work-sheet is provided)
    c) Play "Vocabulary Tic-Tac-Jeopardy" (Instructions and black-line masters are provided)

LESSON # 2

S.T.S. Star Bright Interactive Skit:

Make sure that the parts of the First Officer and the crew members have been assigned and that these individuals have had sufficient opportunity to read and study their assigned parts. (If you choose, have the students decorate the classroom or make costumes!) Hand out the data cards to the rest of the class. There will probably be more data cards than students. Some students may be given more than one data card, or the teacher may hold the extra data cards. (Again, the part of Captain Docent is the teacher's role.)

Have the First Officer and crew members sit at the front of the classroom. Arrange the seats or desks to simulate a conference room on a space ship.

Read the script, have fun!!!

GLOSSARY

abundance:	an ample quantity, a large amount
acquire:	to get, to obtain
aquifer:	water bearing layer of permeable rock, sand or gravel.
axis:	a straight line around which a body or figure rotates
basic human needs:	adequate food, shelter, clothing, health care, and education
botany:	the study of plant life
characteristic:	a distinguishing trait or quality
civilization:	the culture characteristic of a particular time or place
climatic:	relating to the climate
cosmic dust:	very fine particles of solid matter found in any part of the universe
crucial:	important, essential, significant
ecology:	the study of patterns of relations between organisms and their environment
ecosystems:	a community of organisms and their environment. It can apply equally to an area of land or sea or to the entire planet.
emanate:	to flow, to come out from a source
environment:	the physical surroundings of an organism, including all the conditions and circumstances that affect its development
erosion:	the act of wearing away.
expertise:	expert opinion, the skill of an expert
expression:	something that manifests or symbolizes something else
foundation:	an underlying base of support
extinction:	the process of becoming extinct (no longer alive)
greenhouse effect:	the trapping of heat in the atmosphere. In-coming solar radiation enters the atmosphere while out-going heat is absorbed by water vapor, carbon dioxide, and ozone in the atmosphere and re-radiated toward the earth. This causes a rise in temperature.

habitable:	capable of being lived in
hectare:	a metric measure of area equal to 2.47 acres
lethal:	capable of causing death
millennia:	periods of 1000 years, plural of millennium
minute:	very small
moderate:	to lessen the intensity or extremeness of something else
nutrients:	chemicals needed for the functioning and growth of living things.
perish:	to become destroyed or ruined, to die
pertinent:	being clearly appropriate for a particular matter or situation
pollution:	contamination of the environment (soil, air, water) by man-made toxins
radiation:	energy sent out in the form of waves or particles
resource:	a natural source or wealth
rotation:	the spinning motion of a planet or other object on its axis
significant:	a measurably or noticeably large amount
structural violence:	socially damaging actions- pollution, suppression of individual rights, a lack of basic human needs.
sustainable:	meeting present needs without jeopardizing the needs of future generations.
toxic:	poisonous, harmful, destructive
xeno:	strange, foreign
zoology:	the study of animal life.

S.T.S. STAR BRIGHT
VOCABULARY WORKSHEET

Match the correct definitions to the following words:

____ expertise
____ xeno
____ perish
____ botany
____ aquifer
____ emanate
____ pertinent
____ erosion
____ hectare
____ minute
____ abundance
____ millennia
____ zoology
____ acquire
____ significant
____ crucial
____ habitable
____ ecology
____ moderate
____ lethal

1. water bearing layer of rock, sand or gravel
2. a metric measure of area equal to 2.47 acres
3. being clearly appropriate for a particular matter
4. capable of causing death
5. study of pattern of relations between organisms and their environment
6. the study of plant life
7. strange, foreign
8. an ample quantity, a large amount
9. very small
10. to get, to obtain
11. periods of 1000 years
12. expert opinion, the skill of an expert
13. to become destroyed or ruined, to die
14. important, essential, significant
15. the study of animal life.
16. to flow, to come out from a source
17. the act of wearing away.
18. a measurably or noticeably large amount
19. capable of being lived in
20. to lessen the intensity of something else

TIC-TAC-JEOPARDY

INSTRUCTIONS

The purpose of this activity it to review the vocabulary that is used in the interactive skit. It is a tic-tac-toe game that uses an answer format similar to a popular television game show. Prior to conducting this activity, make clear acetate copies of the numbered grids for use on an overhead projector. Use an overhead projector marker to make the X's and O's.

Procedure:

Divide the class into two teams; the X's and the O's. Display one of the numbered grids on the overhead projector, making sure that you have covered the definitions in the cells with pieces of paper. Decide which team will go first. Have each team decide the order in which individual team members will answer. If team X goes first, the first person on team X chooses a cell. The teacher uncovers that cell to display a definition. The team member must state the correct vocabulary word in the form of a question, for example, "What is atmosphere?". If the member on team X answers correctly, an X is placed on the cell. If the member of team X does not answer correctly, an O is placed on the cell. It is now team O's turn.

Play continues until one team has three X's or O's in a straight line, horizontal, vertical, or diagonal.

TIC-TAC-JEOPARDY

GRID #1

the physical surroundings of an organism, including all the conditions and circumstances that affect its development	a natural source or wealth	the trapping of heat in the atmosphere
socially damaging actions-pollution, supression of individual rights, a lack of basic human needs.	strange, foreign	very fine particles of solid matter found in any part of the universe
meeting present needs without jeopardizing the needs of future generations.	very fine particles of solid matter found in any part of the universe	the spinning motion of a planet or other object on its axis

TIC-TAC-JEOPARDY

GRID #2

an ample quantity, a large amount	water bearing layer of permeable rock, sand or gravel.	a community of organisms and their environment. It can apply equally to an area of land or sea or to the entire planet.
a metric measure of area equal to 2.47 acres	to lessen the intensity or extremeness of something else	the study of animal life
capable of causing death	an underlying base of support	to flow, to come out from a source

TIC-TAC-JEOPARDY

GRID #3

something that manifests or symbolizes something else	a distinguishing trait or quality	capable of being lived in
chemicals needed for the functioning and growth of living things.	important, essential, significant	very small
energy sent out in the form of waves or particles	being clearly appropriate for a particular matter or situation	to become destroyed or ruined, to die

TIC-TAC-JEOPARDY

GRID #4

expert opinion, the skill of an expert	the study of plant life	relating to the climate
contamination of the environment (soil, air, water) by man-made toxins	contamination of the environment (soil, air, water) by man-made toxins	a straight line around which a body or figure rotates
the act of wearing away.	a measurably or noticeably large amount	the culture characteristic of a particular time or place

A VOYAGE ON THE S.T.S. STAR BRIGHT

(TEACHER SCRIPT PAGE 1)

Captain Docent:

Greetings Crew Members, and welcome to your new assignments. I am Captain Docent, Commander of the Science Transport Ship Star Bright. Our mission is to provide assistance to federation planets facing environmental problems. Our crew consists of environmental trouble-shooters and scientists with various fields of expertise. Let me introduce you to each other. Our Atmospheric Scientist is Airin Doohe (pronounced "Air-an Dew"). Our Xeno-Botany Specialist is Phawryst Greehan (pronounced "Forest Green"). Fauna Alligee (pronounced "Faw-na Al-i-gee") is our Xeno-Zoologist. Ahkuannett Physhurie (pronounced "Aqua-net Fisherie") is our Aquatic Scientist. Our Conflict-Mediation Specialist is Cearena Amity (pronounced "Sa-re-na Am-i-ty"). The Soil Specialist is Raukee Glebe (pronounced "Rocky Gleeb"). Our Medical Officer is Hippocrates Negus (pronounced "Hip-po-crates Nee-gus"), and my First Officer is Primarius Sirdar (pronounced (Pri-mar-i-us Sir-dar).

Our goal is to help civilizations create and maintain sustainable global environments.

We are currently responding to a call for assistance from the Planet Terah (pronounced "Ter-rah"). First Officer Primarius will give you the pertinent information about this planet.

(STUDENT SCRIPT PAGE 1)

First Officer:

Welcome to the S.T.S. Star Bright. Terah is in the Docias Quadrant, Sector 43, in the Pallinian Galaxy. It is a small, water-laden Type M planet in a stable orbit around a small Type G star known as Theta Minor. Terah has a revolution of .8 Standard Earth Years (SEY) and a rotation of .75 Standard Earth Days (SED). Terah's normal atmosphere contains approximately 79% nitrogen, 21% oxygen, and .03% carbon dioxide. 82% of the planet is covered with oceans. Terah's surface temperature ranges from -91° to 58° on the Celsius scale. There are 4 continental land masses, with significant population centers on each continent. The continents are located in the tropical and temperate regions of the planet. While there are ice masses at the poles, there are no significant land masses in those areas. At the present time, 8% of Terah's land surface is covered by rain forest.

As there is only a very slight tilt in Terah's axis, there is very little seasonal climatic change. This results in a year-round growing season. The Amalgamated Agri-Industries Incorporated was granted colonization rights to Terah 278 years (SEY) ago, and the first colonists arrived 12 years later.

So that we may become better acquainted with each other, we would like you to tell us a little bit about yourselves and your particular area of expertise. Airin, would you please be the first?

Atmospheric Scientist:

Hello. My name is Airin Doohe. I am from the planet of Zonya. I am an Atmospheric Specialist and I received my training at Perez de Cuellar University. Atmosphere refers to the entire envelope of air that surrounds a planet. An atmosphere is composed of a mix of various gases. It protects the surface of a planet from the cosmic dust that continually flow in space, and helps to block the lethal forms of radiation that emanate from stars. The atmospheres on Type M planets naturally create a "greenhouse effect". A naturally occurring "greenhouse effect" is necessary for life to exist .

First Officer:

Thank-you Airin. Raukee, would you please go next?

Soil Specialist:

Greetings. I am Raukee Glebe. Because I am a Soil Specialist, I have often been told that I have a very dirty mind. I was born on the planet of Rubigo and I'm a graduate of Thiru-Staley University.

A very important part of any Type M planet is its top soil. Topsoil is the dark soil, rich in nutrients, that holds moisture. It is the most basic foundation for the support of human life on any planet. The erosion of soil has been a major cause in the downfall of many ancient civilizations. Whenever the erosion of topsoil has destroyed the fertility base of a civilization that civilization has perished. It takes 500 Standard Earth Years for natural sources to produce one inch of top soil. It takes 100 Standard Earth Years for nature to produce 50 tons of topsoil for an acre of land.

First Officer:

Thanks Raukee. Phawryst, would you be next?

(STUDENT SCRIPT PAGE 2)

Xeno-Botanist:

My full name is Phawryst Greehan. I have a degree in Forestry from Primeval State University. I am native of the planet Verdant.

Forests are vital sources of oxygen for any Type M planet. Forests help to moderate climate and prevent floods. Forests recycle and purify water. Forests are homes for millions of species of plants and animals and are a planet's best defense against soil erosion. Forests also influence the heating and cooling of a planet's atmosphere. Of particular importance are the tropical forests on Type M planets. At least half of all the native species of Type M planets live in the tropical forests. Tropical forests are a significant source of oxygen for Type M planets.

First Officer:

We appreciate your comments, Phawryst. Cearena?

Conflict-Mediation Specialist:

Peace, fellow ship-mates. I am Cearena Amity. I was born and raised on the planet Tranquillity. I have a Ph.D. in Counseling from Pacifica University. Many times the result of an unsustainable ecology is war. A breakdown in a society's relationship with the environment often leads to social unrest and violence. Frequently, the goal of a war is to acquire the use of another nation's natural resources for economic gain. However, war is not an inherited human characteristic, it is a culturally determined social idea. The tendency to war is a learned behavior, and learned behaviors can be changed. Society is the expression of the human instinct to cooperate. The instinct to cooperate led people to gather in large social groups. This instinct is crucial for survival.

First Officer:

I am grateful for your insight, Cearena. Ahkwanetta, will you please go next?

Aquatic Specialist:

Good day! I'm Ahkwanetta Physhurie. I hail from the planet Naiad. I have a degree as an aquatic specialist from the Seven Seas Satellite University. A water laden planet is one on which 70% or more of the planet's surface is covered with water . Generally more than 90% of this water is salt water, the type of water usually referred to as oceans. The oceans on a water-laden planet are constantly moving under the influence of the planet's rotation and the heat of its central star. The continuously moving waters interchange warm and cold waters. These changes are extremely important for the ecosystems that exist beneath these waters as well as the ecosystems on land. Various ecosystems are found in oceans. The most common of these are salt marshes, estuaries, mangroves, and coral reefs. While water laden planets contain an abundance of water, only a minute amount is fresh water that is suitable for human use.

First Officer:

Thank you Ahkwanette. Next, is our medical officer.

(STUDENT SCRIPT PAGE 3)

Medical Officer:

Greetings! Let me introduce myself. I am Hippocrates Negus. I received my degree in nutritional medicine from Apollo University of Medical Science. Environmental problems and human problems go hand in hand. The human inhabitants are the most valuable of all a planet's natural resources. However, the lack of basic needs such as food, water, shelter and fuel prevent populations from developing their full human potential. Priorities need to be established regarding human health and welfare.

First Officer:

Thank you Dr. Negus. We still have one more person to introduce, Fauna.

Xeno-Zoologist:

Hello: my full name is Fauna Alligee: I'm from the planet Frith. I received a Master's degree from the University of Eurialis. Biological diversity is important to the existence of all life on any planet. The differences in the various plant and animal species help to provide a balance within ecosystems. Over millennia, on millions of planets, the extinction of certain life forms was a natural process. Natural phenomena such as earthquakes, volcanoes and climate changes were the driving forces behind this process. Today the extinction of species is a human created condition. Human interference has artificially sped up nature's very slow process of extinction.

(END OF STUDENT SCRIPT)

(TEACHER SCRIPT PAGE 2)

Captain Docent:

As you can see, we have a extremely talented crew. However, you have an immensely difficult task ahead of you. The planet of Terah is on the very brink of a global catastrophe. Yet, to their credit, the inhabitants of Terah have resolved to take all possible steps to ensure that they do not go over the edge. (Pause) I have just been informed that we are now in orbit around the planet of Terah.

Your first task is to go to the surface of Terah, and gather the data concerning your various fields of specialty. You must each gather at least seven pieces of important information from various Terahnian experts. When you have gathered your information, please return to the ship along with your Terahn experts for a conference. (Send the crew members out into the classroom to collect their data and experts)

> (**NOTE TO THE TEACHER**: Some crew members may need your assistance to gather the correct data and sources. If needed, help the students form into the various specialty groups. After the crew members and Terahnian experts return to the space ship, the Captain again speaks and gives the following instructions.)

Captain Docent:

Crew members of the S.T.S. Star Bright, you have done well. But this first task was the least difficult of your assignment. Now that you have gathered the necessary information, you and your Terahnian experts must identify the major problems impacting the planet as well as suggest the causes of those problems. Each crew member will confer with the appropriate Terahn committees. Your groups must reach consensus concerning the major problems and their causes. Once your group has reached agreement, the S.T.S. Star Bright crew member will report on the identified problems and the causes to the entire conference.

> (**NOTE TO THE TEACHER**: Direct the various groups to different parts of the room to complete their task. If the teacher has kept the extra data cards, read them aloud and have the groups identify which cards should go to which group. For this section of the activity, the students are identifying the problems and their causes. They are not yet proposing solutions. When each group reaches a consensus, have the S.T.S. Star Bright crew members read the results. Have the First Officer record the findings of the groups on the chalkboard or overhead projector. Label the problems and the causes.)

Captain Docent:

Crew members and Terahnian Committees. You have done well. Your final task is the most difficult, and the most crucial. Each committee must decide on one, and only one recommendation to help to save Planet Terah. In addition, you must also state the reasons for your recommendation. Again, once your committee has reached consensus regarding the recommendation, report it to the First Officer for recording.

(TEACHER SCRIPT PAGE 3)

(**NOTE TO THE TEACHER**: Allow the groups sufficient time to come up with recommendations. Assist the groups as needed. As the groups decide on their recommendations, have the S.T.S. Star Bright crew member report the recommendations to the First Officer, who again records the recommendations on the chalkboard or overhead projector. Once all the groups have reported, discuss the recommendations, asking the students to comment on any similarities or differences. Ask the students to rank the recommendations and identify potential difficulties in implementation.)

Captain Docent:

The time for discussion is finished, we must now make a decision. Crew members and Committee members, we must choose only one recommendation. To do this we will take a vote. (Have students raise their hands to vote, or vote by secret ballot. Have the First Officer report on the results to the class.)

(**NOTE TO THE TEACHER**: This is the end of the lesson. There is no one correct answer for the students to discover. Any answer is correct if it can be justified and helps to save the planet. The process, not the answer, is the important part of this activity. The production of "greef" on this fictional planet was designed to correspond with the beef industry on our Planet Earth. This abstract representation was chosen as we felt this would allow the students to identify problems in a dispassionate manner. The environmental problems associated with the beef industry are enormous. However, solutions to these problems could affect our palates as well as our wallets. It is often difficult to be objective when our stomachs and our money may be involved. We (the authors) are teachers in a middle-school setting. We are also wives and mothers. Until we began doing the research to write lessons concerning environmental issues, we followed rather typical American diets. After researching various environmental issues, we became aware that the typical American diet, with its large consumption of animal products, was a major contributor to these earthly health problems, and to many human health problems as well. This awareness helped us to recognize that large global problems can be impacted by individual choices and actions. It is this idea that we hope to impart to the students. This lesson is expected to take 2 - 3 class periods, longer if set decorations and costumes are used. As a follow-up, students should be assigned to research various earthly environmental problems.)

CONFLICT-MEDIATION SPECIALIST

The four continental nations on Terah are currently spending one trillion dollars per year on military expenses	In order to prevent a planetary ecological catastrophe, cooperation between the various peoples on Terah is necessary.	The most common reason for a war on the planet Terah is the acquisition of another nation's natural resources for economic gain.
The governments on Terah are committing an act of violence known as structural violence against their respective populations.	Even though cooperation is a basic human characteristic, millions of people die prematurely on Terah from a lack of basic human needs.	Structural violence occurs when a society fails to provide for the basic human needs of its population, such as adequate nutrition, safe water, sanitation and health care.
On Terah, less than 3% of the people control more than 86% of the land.	The large land owners use the land under their control to grow the grains, wheace, zempf, and cron or for the non-edible export crop of kauphie.	On Terah, beginning with the middle of the 20th century, there have been on the average 14 wars a year.

WATER

The production of one pound of greef requires 2,500 gallons of fresh water.	The main source of fresh water on Terah's largest continent is the Ogallala Aquifer. At the present time, over 13 trillion gallons of water are being taken from the Ogallala Aquifer every year.	At the present rate of water consumption, the Ogallala Aquifer will be dry in another 35 years. If this occurs, more than 50% of Terah's largest continent will be uninhabitable.
The production of greef accounts for more than 70% of the water pollution on Terah.	A result of dumping industrial wastes into Terah's waterways, is the overgrowth of algae and the depletion of oxygen. Because of this, many of Terah's waterways can barely support fish and other animal life.	Ponds, lakes, streams, and rivers are the main sources of drinking water for nearly 3.6 billion people on Terah.
Crises facing the oceans of Terah: declining fish stock, pollution, destruction of habitat.	Most of the water pumped from the Ogallala Aquifer is used to produce greef.	Only 1% of the fresh water on Terah is available for human consumption.

SOIL

Due to the loss of top soil, the present productivity of Terah's crop land is 70% lower as compared to the productivity when Terah was first colonized.	When first colonized, Terah had 21 inches of top soil.	Terah now has 6 inches of top soil.
At the present time, Terah is losing one inch of top soil every 16 years.	The primary reason for soil erosion is the elimination of tree cover.	In the last 25 years, Terah has lost more than 50 million hectares of arable land due to soil erosion.
On Terah's largest continent, more than 4 million acres of crop land are lost each year to soil erosion.	Only 11% of Terah's land can be cultivated.	It takes anywhere from 100 to 2500 years to form 2.5 cm. of to topsoil.

BOTANY

The people of Terah use only 24 species of plants for food. Three grains; wheace, zempf, and cron make up more than 68% of cultivated crops.	There is enough grain produced on Terah to feed every inhabitant more than 3500 calories per day.	More than just supplying food, plants also help to maintain the mix of gases in the atmosphere that supports all life.
There are over 80,000 species of plants on Terah that are potentially usable for food.	On Terah, plants act as the base of every food chain on land and sea.	50 years ago, 15% of Terah's land mass was covered with temperate forest, and 15% with tropical forest.
In order to grow more of the grains, wheace, zempf, and cron, the forests on Terah are being cut down at the rate of 12,000 square miles per year.	On Terah's smallest continent, 85% of the forest has been cut or burned down.	More than 48% of the grain grown on Terah is used in the production of greef.

AIR

The burning of forests releases soot and harmful gases into Terah's atmosphere.	The atmosphere on Terah is composed of nine layers.	One later of the atmosphere on Terah is the nezo layer, approximately 15 miles above Terah's surface.
The nezo layer of the atmosphere protects the surface of Terah from the harmful nello radiation rays that emanate from Theta Minor.	The gas thenema has been found to destroy the nezo layer of the atmosphere.	Greef factories expel large amounts of thenema into the atmosphere of Terah.
Terah's human inhabitants have created four types of atmospheric pollution: acid rain, smog, depletion of the nezo layer and the release of greenhouse gases.	The naturally occurring greenhouse effect is beneficial to Terah since it enables life to exist. It is created by carbon dioxide reflecting heat from Terah's surface making the planet warm and livable.	In the last 40 years, the amount of carbon dioxide in Terah's atmosphere has increased by 32%. It is predicted that it will increase by 75% in another 70 years and will artificially increase the greenhouse effect.

MEDICINE

On Terah, more than 15 million people die each year due to hunger related diseases.	75% of Terah's population do not have access to adequate sanitation.	Every year, 16 million children die each year from drinking polluted water.
On Terah's second largest continent, nearly 15% of the population are afflicted to some degree with Begael blindness.	Begael blindness is caused from over-exposure to nello radiation.	Less than 25% of the population of Terah are considered to be well fed. The main source of food for this 25% is greef, which is a food source high in protein and fat.
A diet high in protein and fat has been associated with heart disease, strokes, and various types of cancer.	Among Terah's wealthiest inhabitants, heart disease and cancers kill millions of people per year.	

SUGGESTED ADDITIONAL READINGS

Barnaby, F. (Ed.).(1988). Gaia peace atlas. New York; Doubleday.

Franz, D. (Ed.). (1987). Exploring the third world. New York: The American Forum Inc.

MacRae-Campbell, Mikisson & Campbell. (1990). Our only earth series: a global issues curriculum. Tucson,AZ.: Zephyr Press.

Myers, N. (Ed.).(1984). Gaia: an atlas of planet management. Garden City,N.Y.

Postel, S. (1992) Denial in the decisive decade. In L.R. Brown (Ed.). State of the world. (pp.3-8). New York: W.W. Norton & company.

Robbins, J. (1987). Diet for a new America. Walpole,N.H.: Stillpoint.

Tannenbaum, S. (Ed.).(1976). Interdependence curriculum aid. Philadelphia,PA.:World Council of Philadelphia.

The ending hunger briefing workbook. (1984).San Francisco,CA.: the Hunger Project.

Weil, R.(Ed.).(1983). The omni future almanac. New York,N.Y.:World Almanac Publications.

SURVIVAL OF OUR PLANET

(Grades 4-8)

By Vanessa Salas and Susan Perez

INTRODUCTION

Our world is a very complex component of an equally complex entity, our solar system. On planet Earth, humans share space with a number of animals, plants, and insects. Humans, however, are the major contributors to many of our planet's environmental problems. As educators we have a responsibility to provide and share information with our students about existing and potential social and environmental dangers.

In this unit you will be able to incorporate the following skills. Your students will be able to:

1. Take action and responsibility
2. Do research and fact finding
3. Brainstorm possible solutions to environmental issues
5. Identify and understand environmental issues
6. Summarize information orally and in writing
7. Actively participate through cooperative learning and study partners

BACKGROUND

Many existing and potential problems that we face today have occurred in part because of industrialization. Technology, with all of its benefits, has directly, as well as indirectly, created acid rain and air pollution. It has endangered plants and animals, created a greenhouse effect, and damaged the ozone layer. These industry created problems have forced the world to look at the amount of garbage being produced and dumped into our air, water, and soil.

DEFINITIONS

Acid Rain:	When gases from power plants, burned coal, and burned automobile gasoline are released into the air and mixed with water it becomes acidic like lemon juice or vinegar.
Air and Water Pollution:	Contamination from the discharge of waste, gases, and chemicals into the air and water supply creates pollution.
Endangered Species:	When life species begin to disappear because people move in, leaving less space for insects, plants, and animals we create endangered species.
Greenhouse Effect:	Our Earth is naturally surrounded by a blanket of invisible gases that act just like a greenhouse. When the sun shines in, the blanket of gases trap the heat like a roof and keeps it close to our planet. Because factories, electric power plants, and automobiles are making many new gases, more of the sun's heat is being trapped creating a greenhouse effect or global warming.
Ozone Hole:	Ozone is a layer of gas in our atmosphere that blocks out rays from the sun that can harm our skin. Gases called CFC's, from refrigerators, fire-extinguishers, air-conditioners. aerosol cans, and other things can negatively affect the ozone layer.
Recycling:	Separating waste resources and processing them to make new products from the same materials is recycling. For example, newspapers can be recycled into cardboard boxes and beverage cans may be made into new beverage cans.

PROCEDURE

Review with your class the definitions of each environmental issue. Using prior knowledge, have your class list everything they know about acid rain, air and water pollution, endangered species, recycling, the ozone layer, and the greenhouse effect or global warming. Your class may want to diagram or illustrate the effects each of these issues has on our environment.

Brainstorm with your class possible solutions to each of these issues. This will lead to a number of writing activities. Suggested writing activities are: "Futuristic: What will life be like in our world if we ignore the environmental issues of today?", "Change History: How would our lives be different if these problems occurred before the industrial revolution?", "Foresight: What do you think the future holds for us and future generations?", and "Taking Action: What can I do to make a difference?" These stories may be read out loud. This will enable each student to experience these environmental issues through the eyes of another person.

RELATED ACTIVITIES

ACID RAIN

You may simulate acid rain by watering two small plants, one with plain water and the other with a water-vinegar mixture.

1. Regularly water one plant with 1/2 cup water. Water the second plant regularly with 1/2 cup water, and add one tablespoon of vinegar or lemon juice.
2. Check your plant daily to note any visible effects

AIR POLLUTION

In this activity you will compare the different particles that are in the air that produce smog.

1. Use a 2.5 squared piece of waxed paper.
2. Use a pencil and ruler to mark the waxed paper so that it is divided into 1/2 inch squares.
3. Attach the paper to a piece of board with thumbtacks.
4. Smear the paper evenly with a coating of Vaseline.
5. Select an open place at school or in your backyard where the board and paper can remain undisturbed for a week or longer.
6. At the end of this time examine the particles which stick to the Vaseline with a hand lens or a microscope.
7. Choose one of the squares and count the number of different types of particles found on the paper.
8. Count the number of each type of particles found in that square.
9. Select other squares and compare the types and amounts of particles found in them.
10. Organize this information into chart or graph form.

ENDANGERED SPECIES

Birds use up so much energy that they need to eat constantly. Birds may eat up to 4/5 of their weight every day. Birds also need water to drink and stay clean. You can help by making a bird feeder and birdbath.

Bird feeder:

1. Get yarn or string, and orange peels, sliced apples, or shelled, unsalted peanuts.
2. Tie the fruit or peanuts to the yarn and hang them from a tree.
3. Now wait, it will take no time at all for the birds to find them.
4. You may also take a pine cone, tie yarn or string around it, spread peanut butter all over it and hang it from a tree.

Birdbath:

1. All you need is an empty margarine or whipped cream container.
2. Put about two inches of water in the plastic container.
3. Remember to place it high enough to keep out any cats.

GREENHOUSE EFFECT

You may want to arrange for a guest speaker to come in and speak to your class about the controversial issues involved in the topic of global warming. Contacting a spokesperson from an environmental group, a climatologist or weather person from your local TV station, or contacting your local college or university for speakers would be excellent places to start.

OZONE HOLE

Have a discussion with your class about the importance of the ozone layer.

1. Discuss the effects that aerosol cans, refrigerators, air conditioners, and fire extinguishers have on the ozone layer.
2. Ask your students what they can do to help reduce the damage that is being caused. (For example, using non aerosol cans or pump spray bottles, using stick deodorant, or using other materials for packing such as junk mail, newspapers, or old magazines).
3. It's now time for everyone to do their part!

RECYCLING

"Save a tree and carry your own bag". A worthwhile money making project would be for your class to design and make grocery bags to distribute and sell.

1. Gather old fabric scraps, donated fabrics, or cut up old clothes.
2. Cut and sew your fabric into designer grocery bags.
3. Distribute flyers and take orders from homes or school functions such as open house, parent-teacher nights, or any other function your school may organize.

HUMAN ENVIRONMENTAL TRIVIA (HET)

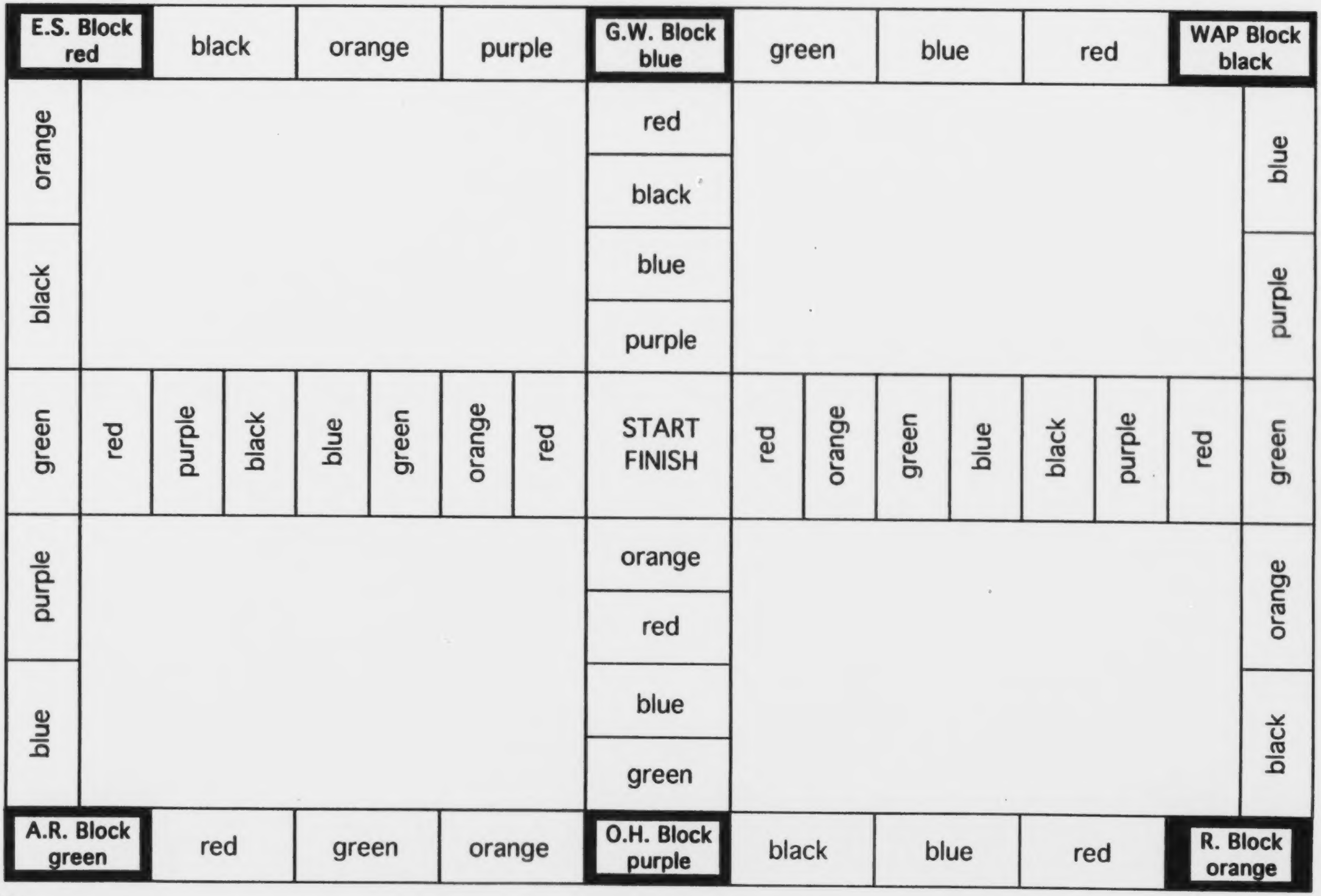
HET is a fun evaluative activity that will enhance recall as well as generate enthusiasm, competition, and cooperation.

1. The object of the game is to reach each category block and answer the corresponding question correctly.
2. Before you begin this game each of your students, along with a study partner, should review the fact sheets provided.
3. Map out your game board on the floor with masking tape, as shown in the diagram. Assign each environmental category square on your game board a different color. You may use colored construction paper. Each category may be represented by one of the following colors:

COLOR	TERM	ABBREVIATION
Red	Endangered Species	E.S.
Blue	Global Warming (Greenhouse Effect)	G.W.
Black	Water and Air Pollution	W.A.P.
Orange	Recycling	R.
Purple	Ozone Hole	O.H.
Green	Acid Rain	A.R.

4. Divide your class into six cooperative learning groups
5. Each group will represent one of the six categories.
6. The first group will begin by rolling the dice. One person from the group will then move the number of spaces indicated on the dice in any direction away from the center of the board. The students themselves will be the playing pieces and actually walk around the board.
7. The color of the space will indicate the category from which the person or group will receive their question.
8. If the group answers correctly they will then roll the dice again. They will continue to roll the dice and move the corresponding number of spaces until they miss answering a question correctly.
9. Once a group has missed a question the turn will then be passed on to another group.
10. The object of the game is to reach each category block and answer it correctly. Once a group has answered a category block they will receive a corresponding colored card from that specific category. After a group has received all six category cards, they must then try to reach the center of the game board. They can only reach the center of the game board by rolling the exact number on the dice. For example if the group is five spaces away from the center, they must roll five on the dice. Once a person is in the center, in order to win the game the group must answer questions from each of the six categories correctly.

Diagram of Game Board


E.S. Block red
black
orange
purple
G.W. Block blue
green
blue
red
WAP Block black
orange
black
red
black
blue
purple
blue
purple
green
red
purple
black
blue
green
orange
red
START FINISH
red
orange
green
blue
black
purple
red
green
purple
blue
orange
red
blue
green
orange
black
A.R. Block green
red
green
orange
O.H. Block purple
black
blue
red
R. Block orange

Ozone Hole-Questions

What is the ozone layer? A. The inner layer of the earth B. A dimension of the twilight zone C. A protective shield that stops the ultraviolet rays of the sun.	What is the main cause of the "ozone hole" ? A. Too many aircraft B. CFC's used in refrigeration and air-conditioning C. Too much heat	What screens out the sun's harmful ultraviolet rays in the upper atmosphere? A. The ozone shield. B. Suntan lotion. C. Clouds.
Where is depletion of the ozone layer greater? A. In the earth's core B. Africa, South America, the South Pole C. Europe, North America and Russia	What products contain CFC's? A. Junk food B. Aerosol sprays, refrigeration, Styrofoam® and insulation C. Motor oil, transmission fluid, brake fluid, and other car products.	Why are CFC's harmful? A. They travel up into the atmosphere and damage the ozone layer. B. They cause loss of hair. C. Because they ruin our crops.
What are the harmful effects of ultraviolet radiation? A. It stunts your growth B. It effects your memory C. It causes skin cancer and lowers the body's immune system	What places use the most CFC's? A. Africa, Mexico, India B. United States, Europe, Japan and Russia C. Iowa, Ohio, Utah	What countries are in danger of receiving harmful rays from the ozone hole? A. Australia, New Zealand, Brazil, Argentina, Chile B. Sweden, Greece, Spain C. Mexico, Africa, India

Ozone Hole-O.H. - Answers

The ozone shield in the upper atmosphere screens out the sun's harmful ultraviolet rays. **A** O.H.	The "ozone hole" over Antarctica, and lower ozone levels globally, are caused mainly by man-made CFC's used in refrigeration and air-conditioning. **B** O.H.	The ozone layer is located about 10 to 20 miles above the earth. It is a protective shield that prevents the ultraviolet rays of the sun from harming life on earth. **C** O.H.
Many consumer products contain CFC's which travel up into the atmosphere and damage the ozone layer. **A** O.H.	Consumer products that contain CFC's include aerosol sprays, air conditioning and refrigerants, foam insulation, Styrofoam® and solvents for cleaning electrical parts. **B** O.H	The depletion of the ozone layer is greatest in the heavily populated areas of Europe, North America and the Soviet Union. **C** O.H.
Some scientists predict that the ozone hole will spread out to encompass larger areas of Australia, New Zealand, Brazil, Argentina, Chile and Uruguay. **A** O.H	CFC's, which decrease the ozone layer, are used most heavily in the United States, Europe, Japan, and the Soviet Union. **B** O.H	Increased exposure to ultraviolet radiation increases skin cancer and depresses the body's immune system, thus lowering resistance to disease and infection. **C** O.H.

Ozone Hole - Questions

A single molecule of CFC can destroy what? A. Brain cells B. Buildings C. 10,000 molecules of ozone	How do CFC's damage the ozone layer? A. They release carbons in the atmosphere B. They release chlorine which attacks the protective zone	What can happen with the depletion of the ozone layer? A. It can cause cataracts B. It can acne C. It can cause perspiration
How does increased ultraviolet radiation affect plants? A. It increases their growth B. It increases their life span C. It decreases their growth	The current measurements of ozone depletion are from what year? A. 1900's B. 1980's C. 1890's	How many years does it take CFC's to travel to the ozone layer? A. Six to eight years B. Sixty to eighty years C. 600 to 800 years
	Why should individuals support ITT? A. Because they are a big company B. Because they said they will stop using CFC's C. Because they are losing money	What are two ways to help protect the ozone layer? A. Stop using solvents that contain CFC's B. Stop buying non-aerosol products C. Stop recycling

Ozone Hole - O.H. - Answers

The depletion of the ozone layer may cause an increased number of cataracts, a clouding of the eye lens which blurs vision. Scientists fear that all people everywhere will be adversely affected by the thinning of the ozone layer. **A** O.H.	CFC's, which damage the ozone layer, are used in foams, solvents, and refrigerants. As they travel upward in the atmosphere, they release chlorine which attacks the protective ozone. **B** O.H.	A single molecule of CFC can destroy 10,000 ozone molecules. This depletes the protective layer of the ozone **C** O.H.
CFC's take six to eight years to travel to the ozone layer, but once there, they stay dangerously active for possibly hundreds of years. **A** O.H.	The current measurements of ozone depletion are alarming, but they only indicate the damage from CFC's released up to the early 1980's. **B** O.H.	Increased ultraviolet radiation may negatively affect plants and crops. Growth of crops may decrease and phytoplankton, the basis of the food chain in the ocean, may be damaged. **C** O.H.
Two ways to help protect the ozone layer include using air conditioning sparingly and writing different manufacturers to ask them to stop using solvents that contain ozone-damaging CFC's. **A** O.H.	Companies such as ITT recently stated that they will stop using CFC's in manufacturing by 1995. Individuals can support such companies by buying their products and giving them publicity. **B** O.H.	

Water and Air Pollution-Questions

What are the major sources of air pollution? A. Airplanes and other aircraft B. Electric cars and solar houses C. Power plants, cars and trash burning	What are some effects of air pollution? A. Asthma relief, longer life B. Can block out sun, create unhealthy places to live C. Sinus headaches	Scientists predict that various forms of pollution may cause: A. Global temperatures to rise B. CFC's to wash away C. Increase in solar energy
Poor nations have many cities that lack: A. Forest and clean land B. Animals and mountains C. Clean water for drinking and bathing	What are some causes of water pollution? A. Animals misusing the rivers B. Sewage, garbage, chemicals, and pesticides C. Dead fish	Where does most of the oil pollution in the ocean come from? A. From car owners, cities and factories B. From tanker accidents C. From people on the beaches
What is another form of air pollution that is found in large cities? A. Solar energy B. Radioactivity C. Urban smog	How have human beings helped to cause air pollution? A. By driving less B. By spewing millions of tons of trace gases into the air yearly C. By recycling	What kinds of trace gases does the atmosphere contain? A. Sulfur dioxide, nitrogen oxides, and CFC's B. Regular, unleaded, and super unleaded C. Methanol, oxygen

Water and Air Pollution-W.A.P.-Answers

Scientists predict that various forms of air pollution may cause global temperatures to rise, the oceans to expand and flood coastal lowlands, interrupt natural food chains, and cause widespread skin cancer among humans. A W.A.P.	Air pollution can affect people all over the earth because polluted air does not stay in one place. Dirty air can block out the sun and create gloomy, unhealthy places to live. B W.A.P.	Major sources of air pollution are power plants, factories, cars and burning trash. The wasted fuel makes smoke, soot and gases, which make things worse when the sources are inefficient. C W.A.P.
Only 12% of ocean oil pollution occurs from tanker accidents. Most of it occurs from deliberate disposal into the waterways by car owners, cities and factories. Ships pollute the oceans when they dump plastic bags, oil, sewage and garbage. A W.A.P.	Water pollution can be caused by sewage, garbage, chemicals, radioactive wastes, and runoffs of chemical fertilizers and pesticides. B W.A.P.	In many cities in poor nations, there is not enough clean water for drinking and bathing. Children get diseases from polluted water. C W.A.P
The atmosphere contains small quantities of trace gases such as sulfur dioxide, nitrogen oxides and chlorofluorocarbons. A W.A.P	Human beings have spewed millions of tons of these trace gases into the air yearly. The increased quantities of trace gases cause many kinds of air pollution. B W.A.P	Another form of air pollution is urban smog, generally found in large cities. Smog is created by combining solar radiation with car and industry exhaust. C W.A.P

Water and Air Pollution - Questions

How can air pollution cause damage to a person's health? A. It causes sinus relief B. It causes muscle tension C. It causes birth defects, lung diseases	The levels of man-made ozone present in our atmosphere have more than: A. Tripled in the last 100 years B. Doubled in the last 100 years C. None of the above	How can smog harm humans? A. By causing eye irritation, and impairing breathing B. By causing our hair to fall out C. By causing the common cold
What can a single individual do to reduce air pollution? A. Take the car on a lot of short trips B. Take your car in for oil changes once every ten years C. Join car pools	Pollution related cancer is due to: A. Increased use of chemicals in the last 3 to 4 years B. Increased use of chemicals in the last 30 to 40 years	Who are the most susceptible to the effects of air pollution? A. Babies, children B. Animals, insects C. Trees, plants
What are disposable goods? A. Food such as chips, candy etc. B. Clothing and other cloth materials C. Throw-away diapers, razors, lighters, etc.	What are some ways to conserve energy? A. By turning the air conditioner on and off B. By insulating your home C. By making sure you keep a night light on	How can you help reduce some toxic emissions? A. Riding bicycles or walking B. Use your car more C. Pick up trash

Water and Air Pollution - W.A.P. - Answers

Smog harms humans by causing eye irritation and impairing breathing. Smog also damages plants, crops, and forests and erodes buildings and monuments. **A** W.A.P	Man-made ozone, mostly from car and industry exhaust, is damaging to living and non-living things. The levels of man-made ozone present in our atmosphere have more than doubled in the last 100 years. **B** W.A.P	Air pollution is damaging to human health. It causes birth defects, lung and cardiovascular diseases as well as cancer. **C** W.A.P.
The people most susceptible to air pollution include babies, children and people with respiratory or heart diseases. **A** W.A.P	Pollution related cancer is on the rise and may be due to the increased use of chemicals in the last 30 to 40 years. **B** W.A.P	There are many things an individual can do to reduce air pollution. To decrease carbon dioxide emission, for example, individuals can join car pools or use public transit. **C** W.A.P
Riding bicycles or walking when possible, instead of driving, can help reduce some toxic emissions. **A** W.A.P	Conserving energy by insulating homes, turning off lights when not needed and using appliances only when necessary will also help reduce air pollution. **B** W.A.P	Individuals can also reduce their use of disposable goods. Take a survey at home, noting how many disposable goods, such as disposable diapers, razors, lighters, utensils, etc. are used on a daily basis. **C** W.A.P

Water and Air Pollution - Questions

What is the Montreal Protocol?	What did the U.S ban in 1978?	What kinds of groups should individuals support?
A. A treaty that bans all products B. A treaty that states that everyone will conserve energy C. A treaty that states that CFC emissions will be reduced by 50% by the year 1998.	A. The use of solar power B. The use of aerosol products C. The use of nuclear power	A. Groups that attempt to preserve tropical rain forests B. Groups that attempt to change the world

Water and Air Pollution - W.A.P. - Answers

Individuals can support groups that attempt to preserve tropical rain forests and refuse to use products from the rain forests such as rattan, teak or mahogany furniture. **A** W.A.P	Countries have begun and must continue to take action to reduce air pollution. In 1978, the U.S banned the use of most aerosol products. **B** W.A.P	In 1987, 35 countries signed an international treaty called the Montreal Protocol. This treaty states that CFC emissions will be reduced by 50% by the year 1998. **C** W.A.P

Acid Rain-Questions

What makes acid rain? A. Too much oil in the air B. Too much salt in the atmosphere C. When certain gases are released into the air	What is the difference between pure rainwater and acid rain? A. Acid rain has a pH above 5.6 B. Acid rain has a pH below 5.6 C. Acid rain has no pH	Most acid rain is caused by what? A. Too much sulfur dioxide and nitrogen oxide in the air B. The pesticides in the air C. Animals and insects
Who are the first organisms to show ill effects from acid rain? A. People B. Plants C. Aquatic animals	What kind of damage can acid rain cause? A. It causes the lakes to dry up B. It can keep seeds from germinating C. It causes plants to pollinate	What is the cause of acid rain? A. Gases get into rain clouds, where they get mixed in with rain or snow B. Gases get into the lakes and then cycle into the air
What is another factor that determines how far the pollutants travel? A. The amount that is deposited B. How low it is deposited C. How high it is deposited	When gaseous pollutants are deposited into the atmosphere, how far do they go? A. Two miles B. Hundreds of miles C. Millions of miles	What kinds of things can acid rain affect? A. It affects the drinking water, and our soil B. It affects our clothing and hair C. It affects the sidewalks and streets

Acid Rain-A.R. - Answers

Too much acid rain hurts trees, lakes, rivers, soil and living things. Most acid rain is caused by too much sulfur dioxide and nitrogen oxide into the air, from fossil fuel-burning factories, plants and motor vehicles. A A.R.	Pure rainwater has a pH of between 5.6 and 6.0 . Acid rain is rain with a pH below 5.6. Sulfuric acid and nitric acid account for ninety-five percent of the acids in acid rain. B A.R.	When power plants burn coal to make electricity, and when cars burn gasoline, invisible gases are released into the air. These gases can mix with water and make it acidic, like lemon juice or vinegar. C A.R.
The gases get into rain clouds, where they get mixed in with rain or snow. Then the acid falls back to earth with the rain or snow. This is called acid rain. A A.R.	Acid rain can harm plants by damaging outer leaf surfaces and by changing the root environment. Acid rain has been found to strip away the waxy protective coating from coniferous needles. Acid rain can keep seeds from germinating. B A.R.	Acid rain destroys our soil and water resources. Because the acidic water permeates their entire environment, aquatic animals are among the first to show ill effects. C A.R.
Acid rain can affect the quality of the water we need for drinking and washing. It can affect the soil, which we need to grow food to support human life and to build dwellings. A A.R.	Acid rain often falls far from its polluting source. Once deposited into the atmosphere, airborne gaseous pollutants are often blown hundreds of miles. Pollutants can stay aloft for four days or longer. B A.R.	Another factor affecting how far the pollutants travel is how high they are deposited in the atmosphere. The tallest smoke stacks can deposit the pollutants high in the atmosphere, where they get carried by powerful winds. C A.R

Acid Rain - Questions

Where is acid rain found? A. On other planets B. Only in the U.S C. All over the world	What are the two main acids in acid rain? A. Sulfuric acid and acetic acid B. Sulfuric acid and nitric acid C. Sulfuric acid and salicylic acid	How does acid rain harm trees and plants? A. It causes the soil to become acidic and causes plants to turn brown and die B. It causes plants to become deformed
How much financial damage does acid rain cause? A. Thousands of dollars B. Billions of dollars C. Just a few cents	Acid rain can be generated in one country and end up where? A. On another planet B. In another country C. Underground	What does acid rain do to buildings and cars? A. Eats away the stone on buildings and produces spots on car paint B. Restores them to their original color
	Where have entire forests died due to acid rain? A. United States B. Bavaria and West Germany C. Mexico	Where does acid rain cause billions of dollars of damage? A. United States B. Mexico C. Africa

Acid Rain - A.R. - Answers

Sometimes acid rain makes the soil itself too acidic, or harms leaves, so that trees and other plants turn brown and die. **A** A.R.	When the rain comes down, these acids mix with the rain water to produce a solution of sulfuric acid and nitric acid. These are the two main acids in acid rain, and they can be deadly. **B** A.R.	Acid rain is found all over the world, from Mexico to Sweden, England to Japan, India to Canada. **C** A.R.
Acid rain can eat away the metal and stone in bridges, buildings, and statues. It can produce spots on car paint. **A** A.R.	Acid rain, sleet, snow, and wind often travel great distances before being deposited. Acid rain is frequently generated in one country but deposited in another. **B** A.R.	Acid rain causes billions of dollars of damage to land, crops, forests, lakes and marine life each year. **C** A.R.
Acid rain is destructive to buildings and monuments. It does billions of dollars of damage in the United States each year. **A** A.R.	In Bavaria and West Germany, entire forests have died due to acid rain. In Sweden, 4,000 lakes have died from acid rain. **B** A.R.	

Acid Rain - Questions

What are the effects of sulfuric acid and nitrogen oxides? A. Blindness, and deafness B. Loss of speech C. Penetration of the lungs with toxic chemicals, and irritation of the lungs	How many lakes have been damaged due to acid rain? A. 50 B. 1,734 C. 100	How many tons of sulfur dioxide are pumped into the sky each year? A. 25 million tons B. 25 hundred tons C. 25 thousand tons

Acid Rain - A.R. - Answers

Acid rain is caused by emissions of sulfur dioxide and nitrogen oxides. Each year, almost 25 million tons of sulfur dioxide are pumped into the sky, primarily from furnaces run by coal-burning utilities. A A.R.	At least 1,734 large lakes have been damaged due to acid rain, at substantial cost to tourism, fishing, and lumber industries. B A.R.	Droplets of highly concentrated sulfuric acid can penetrate deep into the lungs, carrying with them toxic chemicals and gases. Nitrogen oxides are known to narrow airways and irritate the lungs. C A.R

Endangered Species-Questions

What is the major cause of plant and animal extinction? A. Pollution B. Over hunting C. Habitat destruction	Why would the extinction of insects be devastating? A. Because other animals would die B. Because most of the important crops are pollinated by insects C. Because we would no longer use pesticides	By the year 2000, it is estimated that in one year as many as 50,000 species could be lost due to what? A. Habitat destruction, pollution, over hunting B. Old age, diseases C. Drownings, earthquakes
Just twenty plant varieties provide how much of the world's food supply? A. 10% B. 50% C. 90%	What is used in agriculture that affects wildlife populations? A. Too much fertilizers B. Pesticides and insecticides C. Irrigation	What is another cause of extinction? A. Overhunting and exploitation B. Animals kill each other C. Lack of food
Scientists predict that within a year, the number of vanished species, might total what? A. 17 B. 175 C. 17,500	How many dolphins are killed in a year by international tuna fleets which catch yellowfin tuna? A. 100 B. 100,000 C. 1,000	Tropical rain forest contain how much of all the world's species? A. Two-thirds B. One-half C. All of it

Endangered Species-E.S. - Answers

By the year 2000, due to habitat destruction, pollution, over hunting, or the introduction of a new species into a new habitat, it is estimated that as many as 50,000 species could be lost in one year. **A** E.S.	The extinction of insects would be environmentally devastating. Insects play an important role in the ecosystem as pollinators. Most of the important crops in the U.S are pollinated by insects. **B** E.S.	Habitat destruction caused by land development, hydroelectric projects, building roads and even war, is the major cause of plant and animal extinction. **C** E.S.
Over hunting and exploitation of certain species, such as the whale is another cause of extinction. **A** E.S.	Many species are threatened by pollution. Estuaries and marine areas are damaged by siltation, chemical and petroleum pollution. Pesticides and insecticides used in agriculture affect wildlife populations. **B** E.S	Human beings depend on the well-being of plant and animal species. Wild plants and animals provide us with food, medicine, and industrial raw materials. Just twenty plant varieties provide 90% of the world food supply. **C** E.S
Tropical rain forests contain more than two-thirds of all the world species. Habitat destruction is a major threat to all forms of life in the tropical rain forests. **A** E.S.	Every year more than 100,000 dolphins are killed in mile-long purse seine nets used by international tuna fleets to catch yellowfin tuna. **B** E.S.	Some scientists predict that before this day ends, 45 kinds of plants and animals will die. In a month, 1,400 species could be lost forever. Within a year, the number of vanished species, might total 17,500. **C** E.S.

Endangered Species - Questions

What happens when a species disappears? A. They reappear years later B. They turn into another species C. Their gene pools also disappear	Why is over hunting one of the four leading causes of extinction? A. Because humans don't know which animals to hunt B. Because humans kill animals faster than they can reproduce	What are the four main ways people are causing extinction? A. Destroying habitats, over hunting, pollution, introducing new species B. Cutting down trees, over feeding, experimentation, hunting
How can each person help reduce the demand for products that threaten the habitats of plants and animals? A. By staying out of the forest B. By eating less C. By recycling	What is one of the ways used to preserve wildlife around the world? A. By taking away guns B. By establishing wildlife preserves C. By hiding all the animals	What helps stop the trade in threatened species? A. Worldwide agreement called CITES B. Animals Union C. The Hunters Union
What is the fourth largest island in the world? A. Hawaii B. Catalina C. Madagascar	What is the Endangered Species Act? A. This act outlaws wildlife parks and preserves B. This act outlaws disturbing habitats, hunting or trading of endangered species	What is the most important way to help reduce the number of endangered species? A. By educating others about efforts to save wildlife B. By setting up traps for hunters

Endangered Species - E.R. - Answers

People are causing extinction in four main ways. These include destroying wildlife habitats, over hunting, introducing new species that endanger native wildlife and pollution of the environment. **A** E.S.	Over hunting is one of the four leading causes of extinction. Humans kill animals faster than they can reproduce. **B** E.S.	Each mammal, plant or insect that becomes extinct takes genes with it that could have been very valuable. As species disappear, so do their gene pools. **C** E.S.
One worldwide agreement called CITES, the Convention on International Trade in Endangered Species, has been adopted by over 80 countries and helps to stop the trade in threatened species. **A** E.S.	One of the ways used to preserve wildlife around the world has been to establish wildlife parks and preserves. Today, there are 3,500 areas around the world that are protected from destruction. **B** E.S.	Each person can help reduce the demand for products that threaten the habitats of plants and animals by recycling. Recycling can be done at home, at school and in local communities. **C** E.S
One of the most important ways to help reduce the number of endangered species is for students to inform and educate others by word of mouth, letter writing, and staying informed about efforts to save wildlife. **A** E.S	In 1973, the United States adopted the Endangered Species Act. This act outlaws disturbing the habitats, hunting or trading of endangered species; but there are many problems with enforcing the act. **B** E.S	Madagascar, off the eastern coast of Africa, is the fourth largest island in the world. Fifteen hundreds years ago, early explorers found an island entirely covered with forest. **C** E.S.

Endangered Species - Questions

	What has happened to three different giant flightless birds, two giant tortoises and eleven species of giant lemurs? A. They have reproduced B. They are all extinct	How much of the forest has been cleared in Madagascar? A. Four-fifths B. One-half C. One-third

Endangered Species - E.R. - Answers

Today, four-fifths of the forest has been cleared in Madagascar. Nearly 150,000 hectares of forest are cleared away every year. This habitat destruction is responsible for the loss of a variety of animals. **A** E.S.	At one time, three different giant flightless birds, two giant tortoises and eleven species of giant lemurs could be seen in Madagascar. Today they are all extinct. **B** E.S.	

Global Warming-Questions

What gas accounts for about half of all greenhouse gases? A. Nitrous oxide B. Carbon monoxide C. Carbon dioxide	What greenhouse gases contribute to global warming? A. Regular, unleaded gases B. Carbon dioxide, methane, CFC's, nitrous oxide C. Carbon monoxide, H2O, sulfuric acid	Where does the threat of global warming come from? A. Greenhouse gases in the air which prevent heat from escaping into space B. The sun coming closer to earth
What accounts for about half of the greenhouse effect? A. Plants, animals, and people B. Recycling problems C. Fossil fuels, such as coal, oil and natural gas	What is the critical threshold at which severe and unpredictable reactions will take place in the earth's atmosphere? A. Greenhouse warming B. Greenhouse factor C. Greenhouse gases	Why is it important not to cut down more trees than we plant? A. Cutting down more trees than we plant increases global warming B. Because animals need them for housing
Where does carbon dioxide come from? A. Plants and animals B. By-product from our environment C. By-product from burning fossil fuels such as wood and coal	What is carbon dioxide? A. A new medication B. A colorless, odorless, and tasteless gas C. A gas we use to help our environment	What is it called when solar radiation penetrates the atmosphere and warms the earth? A. Greenhouse effect B. Ozone hole C. Summer

Global Warming (Greenhouse Effect) - G.W. - Answers

The threat of global warming comes from greenhouse gases in the air which prevent more than the natural amount of the earth's heat from escaping into space. **A** G.W.	Greenhouse gases that contribute to global warming are water vapor, carbon dioxide, methane, CFC's, ground-level ozone and nitrous oxide. **B** G.W.	Carbon dioxide accounts for about half of all greenhouse gases and has increased to record levels. In the U.S, burning coal, oil and natural gas to heat homes, produce power, generates vast amounts of carbon dioxide. **C** G.W.
Trees absorb lots of carbon dioxide in order to grow. Trees also produce oxygen that we breathe. Cutting down more trees than we plant increases global warming. **A** G.W	The greenhouse factor is the critical threshold at which severe and unpredictable reactions will take place in the earth's atmosphere. **B** G.W.	Fossil fuels, such as coal, oil and natural gas, account for about half of the greenhouse effect. **C** G.W.
Solar radiation penetrates the atmosphere and warms the earth. The earth then re-radiates this heat energy back into the atmosphere. The trace or greenhouse gases trap the heat energy reflected from earth. **A** G.W.	Carbon dioxide is a colorless, odorless, and tasteless gas. It is the most important greenhouse gas and represents about half of the greenhouse problem. **B** G.W.	Carbon dioxide is a by-product from burning fossil fuels such as wood, coal, petroleum products, natural gas and other materials containing carbon. **C** G.W.

Global Warming-Questions

If the greenhouse effect is left ignored what could happen? A. Absolutely nothing B. More earthquakes C. Climate patterns will change	The amount of what has increased 30% since 1860? A. Methane B. Carbon dioxide C. Nitrous oxide	Carbon dioxide is very efficient at doing what? A. Absorbing the heat of our planet B. Producing more plants C. Absorbing other gases from our atmosphere
The warming of our atmosphere will cause what to happen? A. It will cause nicer summers B. It will cause plants to grow more efficiently C. It will cause more evaporation to take place	What could happen to our hurricane season if the oceans warm further? A. They will not last as long B. They will last longer C. It will make no difference	What has risen about 1 degree Fahrenheit in the last 100 years? A. Global air temperatures B. U.S.A air temperatures C. Russia's air temperature
What can one individual do to help against the greenhouse effect? A. Use paper bags B. Control recycling C. Plant a tree	What could happen if we let our ocean waters warm? A. The animals will not freeze B. The polar ice caps and glaciers will melt C. The beaches will be better	What will global warming do to our Tropics? A. Produce storms with up to 50% more energy B. Produce more trees and plants C. Produce healthier fruits and vegetables

Global Warming (Greenhouse Effect) - G.W. - Answers

The impact of carbon dioxide upon the atmosphere appears insignificant. It makes up less than one half of 1% of the total atmosphere. Carbon dioxide is very efficient at absorbing the heat off our planet. **A** G.W.	The amount of carbon dioxide in the atmosphere of our planet has been increasing at an alarming rate since the mid to late 1800's. The amount of CO2 has increased nearly 30% since 1860. **B** G.W.	The greenhouse effect left ignored and unchecked will not only cause warmer temperatures, but will change climate patterns as well. This will dramatically alter the way we live. **C** G.W.
Global air temperatures have risen about 1 degree Fahrenheit in the last 100 years. The last one degree of warming took 2,000 years. **A** G.W.	Global warming heats our oceans. Oceans cover nearly three-fourths of the earth. If the oceans warm further, the hurricane season, now 6 months long, will last longer. **B** G.W	The warming of our atmosphere will cause more evaporation to take place, bringing severe droughts. During the summer of 1988, the United States experienced the worst drought recorded since the 1930's. **C** G.W.
Global warming will produce storms in the Tropics with up to 50% more energy and winds reaching more than 200 miles per hour. **A** G.W.	As the air surrounding our planet warms, the ocean water warms and expands. As the ocean waters warm, the polar ice caps and glaciers will melt. Increases in sea-level would effect the entire 12,383 mile coastline of the U.S. **B** G.W.	To help combat the greenhouse effect plant a tree. Trees absorb carbon dioxide. **C** G.W.

Global Warming - Questions

	The composition of forests is likely to change due to what? A. The increased oxygen in the atmosphere B. The increased carbon dioxide in the atmosphere	How can individuals help reduce the global warming and ozone problems? A. Through political action B. By hoping that it goes away C. By moving elsewhere

Global Warming (Greenhouse Effect) - G.W. - Answers

An individual can help reduce the global warming and ozone problems through political action. They can write letters or form committees to lobby for better environmental protection. **A** G.W.	The composition of forests is likely to change as trees that grow better in increased carbon dioxide atmosphere replace those that do not. **B** G.W.	

Recycling-Questions

How many pounds of trash does the average person throw away in the U.S? A. 30 to 50 pounds B. 1 pound C. 3 to 5 pounds	What can reduce the solid waste that we send to landfills? A. Reheating B. Recycling C. Refilling	What can we do with waste that can't be reduced, reused, or recycled? A. It can be disposed of in well engineered, safe landfills B. Bury it in the ocean C. Burn it
What percent of the trash in landfills is packaging materials such as boxes, bags, and wrappers? A. 50% B. 3% C. 32%	How many aluminum cans are being thrown away instead of being recycled? A.34.8 thousand B.34.8 billion C. 34.8 hundred	What item is thrown out more than any other waste? A. Paper B. Aluminum C. Styrofoam
What does the term reduce mean? A. Make new products out of old B. Cut down on the amount of materials used C. Use something again	What does the term recycle mean? A. Use something again B. Make new products out of old C. Cut down on the amount of trash used	What does the term reuse mean? A. Cut down on the amount of trash used B. Make new products out of old C. Use something again

Recycling-R. - Answers

There will always be waste that cannot be reduced, reused, or recycled but can be disposed of in well engineered, safe, strictly regulated landfills. **A** R.	Recycling solid waste such as paper, plastic, glass, metal, and rubber can reduce the solid waste that we send to landfills. **B** R.	In the U.S. each person throws away 3-5 pounds of trash daily. **C** R.
Paper is thrown out more often than any other solid waste. **A** R.	Each year 34.8 billion aluminum cans are thrown away, rather than being recycled. **B** R.	32% of the trash in landfills is packaging such as boxes, bags, wrappers. **C** R.
Reuse means to use something again. **A** R.	Recycling means to make new products out of used materials like beverage containers, newspapers, and glass. **B** R.	Reduce means to cut down on the amount of materials we use. **C** R.

Recycling - Questions

What percent of our trash is recycled? A. 1% B. 3% C. 13%	What percent of our garbage is burned in incinerators? A. 1% B. 14% C. 4%	What percent of our garbage is buried in landfills? A. 73% B. 33% C. 7%
What is pollution? A. A bad disease B. Air in the atmosphere C. Contamination of water, soil and air	How many states have recycling laws? A. 2 B. 26 C. 10	What is it called when we burn trash to create energy? A. Waste to energy B. Energy to waste C. A waste of time
What kind of items can be recycled? A. Nuclear waste B. Liquid chemicals C. Glass, aluminum, newspaper, plastic	What happens to sewage? A. Carried off by sewers and settles underground B. Carried off by sewers and purified in a sewage treatment plant C. Nothing	What is solid waste? A. Trash or garbage B. Rocks and dirt C. Wasted air in the atmosphere

Recycling - R. - Answers

73% of our garbage is buried in landfills. **A** R.	14% of our garbage is burned in incinerators. **B** R.	13% of our trash is recycled. **C** R.
Resource recovery or waste to energy means burning trash to create energy. **A** R.	26 states have recycling laws that in some cases force local governments and citizens to participate in collection efforts. **B** R.	Pollution is the contamination of soil, water, and/or air from the discharge of waste, gases, or chemicals. **C** R.
Solid waste is trash or garbage. **A** R.	Sewage is liquid or solid waste which is carried off by sewers and purified in a sewage treatment plant. **B** R.	Almost all natural and some man-made materials such as glass, aluminum, newspaper, cardboard, tin, plastic, and natural oils are recyclable. **C** R.

SUGGESTED ADDITIONAL READINGS

Hocking, C., Barber, J., & Conrad, J. (1990). Acid rain. Berkeley, California: Lawrence Hall of Science, University of California.

Hocking, C., Sneider, C., Erickson, J. & Golden, R. (1990). Global warming and the greenhouse effect. Berkeley, California: Lawrence Hall of Science, University of California.

Javna, J.(1990). 50 simple things kids can do to save the earth. Kansas City, Andrews and McMeel A Universal Press Syndicate Company.

MacEachern, D. (1990). Save our planet. New York, New York: Dell Publishing Inc.

MacRae-Campbell, L. & McKisson, M.(1990). Endangered species: Their struggle to survive. Tuscon, Arizona: Zephyr Press.

MacRae-Campbell, L. & McKisson, M. (1990). Our troubled skies. Tuscon, Arizona: Zephyr Press.

MacRae-Campbell, L. & McKisson, M. (1990). The ocean crisis. Tuscon, Arizona: Zephyr Press.

Phillips, E. (1990). Crisis in the atmosphere: The greenhouse factor. Phoenix, Arizona: D.B. Clark & Co. Publishing.

Wentworth, D.F. (1971). Pollution - examining your environment. Toronto, Canada: Holt, Rinehart and Winston, Limited

THIRTY DAY ENERGY CONSERVATION CALENDAR

(Grades 5-8)

By Vanessa Salas and Rhonda Gross

The earth is like a space ship; it has all of the fuel necessary for its voyage. Man, however, is using the Earth's limited fuel resources faster than new energy sources can be found. Ninety percent of the energy used in the United States today comes from non-renewable sources. One day these energy sources might be used up. This problem has created an energy source crisis.

As people are looking for new sources of energy, they are also being more careful not to waste existing energy resources. The Thirty Day Energy Conservation Calendar is designed to teach students how to become better energy conservers through daily activities and motivators. At the end of the month the students will have tried thirty different ways to save energy. Our goal is that they might find five of these daily activities easy enough to do and that they will continue to fit them into their lifestyle.

KEEP YOUR TIRES PUMPED

ACTIVITY FOR DAY 1

Introduction:

Most children don't understand how keeping the proper amount of air pressure in the family car will save energy. This easy activity will help them grasp how much harder the car engine must work when tire pressure is low.

Objectives:

Students will . . .

1. Take a resting pulse rate and two pulse rates while riding a bicycle.
2. Graph his or her pulse rates.
3. Evaluate the differences between a human's use of energy and a car's use of energy.

Materials:

(a) School parking lot that has been blocked off from traffic
(b) Several bicycles with properly inflated tires
(c) Tire air pressure gauge
(d) Clipboard, pencil and paper
(e) Several watches with second hands
(f) Stopwatch
(g) Candy bar
(h) Graph paper

Anticipatory set:

Hold up a candy bar and say, "I am feeling run down this morning (or afternoon)". "What will happen if I eat this candy bar." Solicit the answer that if you eat the candy bar you will get quick energy. State to the class, "This candy bar will provide the energy to get `my motor running'." Ask the class, "Do you know what kind of energy source gets your car motor running?" They will all say gas is the energy source that the car needs.

Tell the class, "Your body is like a car in that it needs energy to get you from one place to another." Ask the class, "How do you know when your body is working hard?" Look for answers such as sweating, breathing hard, and the heart beating faster. "You can measure how hard your body is working by taking your pulse." Instruct your students on how to take their pulse rates. Use a watch or clock with a sweeping second hand, and time for 15-second increments and multiply by 4 to measure the pulse rate.

Record all of the students' pulse rates on a chart marked off with three columns. "Are you working hard right now? When you are sitting around like we are the pulse rate will be low because the heart doesn't have to pump blood to the body very fast; this is called your resting pulse rate." Say to the class, "We are going to use our pulse rates to measure how hard our bodies are working, by going outside and riding some bicycles."

EXPLORATION

Have a marked off circular path in the school parking lot, including a starting line. Use orange pillions (P.E. coaches usually have several) to close off the parking lot for safety purposes. Instruct two or three students (depending on the number of bicycles) to ride the bicycles until you tell them to stop. Time them with the stopwatch for two minutes and then yell "STOP." Ask the students to measure their pulse rate as soon as they stop. Record this rate on the chart in column number two. All students should take turns riding the bikes and measuring and recording their pulse rates. When the students are not riding they should be sitting down to keep their pulse rate low.

Use the tire pressure gauge to release 10 pounds of pressure from each tire of all the bicycles. Ask each student to ride the same bicycle they rode the first time for 2 minutes, stop, and take their pulse rates. Record these rates in the third column of the chart. All students should take turns riding the bicycles. Return to the classroom.

LABELING

Graph the combined resting pulse rates of the entire class from column one of the chart. Then add to the graph the combined pulse rates of the class when they rode the properly inflated bicycles which is found in column two. Finally add the class pulse rate total while riding the deflated bicycles from column three. When the entire class pulse rates are totaled together and graphed the differences between the pulse rate totals show up greatly. Each student should also make a graph of his or her individual pulse rates from the activity.

EXPRESSION

To summarize this activity ask the students to answer several questions. These questions might also be used to initiate a small group discussion.

1. Why is it important to check the tire pressure on your bicycle?
2. What do you think happens when a car's tires aren't properly inflated?
3. When we need more food energy we can grow more. What happens when we run out of gas?
4. Will we always be able to get more gas?
5. How can keeping your family car tires properly inflated help save energy?
6. What are the differences between the ways humans use energy and the ways a car uses energy?

FACT SHEET FOR CALENDAR

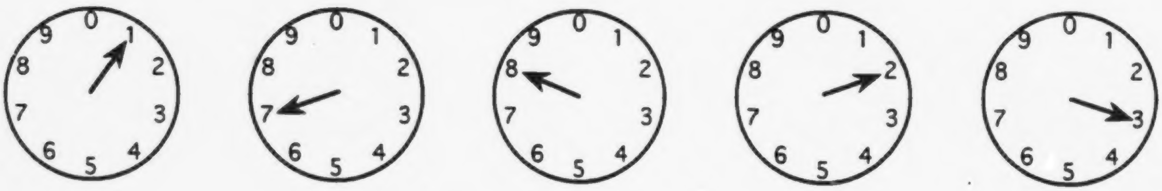
DAY 1	This will be an activity you will do at school this week.
DAY 2	About 10 percent of home electricity consumption is for lighting.
DAY 3	Complete activity for day 3 to find out why this is important
DAY 4	You can reduce the amount of electricity you use for lighting without sacrificing convenience, by using the most efficient fixtures and bulbs, placing them strategically for maximum benefit, and insuring that you don't use lights unnecessarily.
DAY 5	A quarter of all the energy used in the U.S is used directly for transportation.
DAY 6	The U.S is now recycling 50% of all aluminum cans.
DAY 7	A color television consumes 528 kilowatts an hour (cost per kilowatt is nine cents).
DAY 8	You can reduce the amount of energy used for air conditioning by reducing heat transfer. Close draperies and shades on sunny windows, but be careful not to block the air vents for your air conditioner.
DAY 9	When you open the refrigerator, the cold air you feel coming out is trading places with the hot air going in. That means the fridge is getting warmer inside, and has to use lots of extra electricity to cool down.
DAY 10	The water heater consumes 4,219 kilowatts an hour (remember, the cost per kilowatt is nine cents).
DAY 11	Today the students will ride the bus on a field trip.

DAY 12

APPLIANCE	KILOWATT-HOUR
1. Water heater	4,219
2. Refrigerator	1,500
3. Clothes Dryer	993
4. Air conditioner	860
5. Oven	626
6. Television	528
7. Dishwasher	165
8. Microwave	100
9. Stereo	109
10. Washing machine	103
11. Vacuum cleaner	46
12. Hair Dryer	25

DAY 13 The average person uses about half as much hot water in a shower as in a bath.

DAY 14 Reading a meter is very much like reading any number. Take 17823. The 3 represents ones, the two represents tens, the 8 represents hundreds, the 7 represents thousands, and the 1 represents ten-thousands. On the face of your meter are several dials with pointers like watch faces. The pointers turn very slowly when electricity is being used. They do not turn in the same direction-every other one turns counterclockwise. The dial to the far right represents one, the one to the left of it represents tens, and so forth.
To keep track of your electricity use, read your meter monthly on the same date. Subtract the previous month's reading from the present month's reading, and multiply the result by ten. The result will be the kilowatt hours used for the month.



DAY 15 Since the things you use are all made from materials that come from the Earth, they're still valuable, even when you don't need them anymore. By passing them on to other people instead of throwing them away, you can make less garbage and save precious resources.

DAY 16	Our Earth's treasures are being thrown out as trash! Millions of pounds of plastic made by factories can be recycled, but are thrown away instead.
DAY 17	The energy you get from batteries comes from the Earth. Don't waste it. Americans buy two billion disposable batteries every year. These disposable batteries are used up and tossed out and that's not good for the Earth. Most batteries contain mercury, a dangerous metal that can leak into the ground when the batteries are thrown away. Here's some good news: there is a battery that you don't have to throw away-it's called a "rechargeable" battery.
DAY 18	Americans use 50 million tons of paper every year, or about 580 pounds for each person. To make all that paper, we use more than a billions trees. If everyone in the U.S. recycled their Sunday newspaper, we'd save 500,000 trees every week.
DAY 19	It takes 55 square feet of rain forest to produce 1/4 pound of beef. Imagine all the different types of energy that you can save by reducing the amount of meat that you eat.
DAY 20	Complete the "Make recycled paper" activity.
DAY 21	Complete the "Fuel for the Future" activity.
DAY 22	Complete the energy graph worksheet
DAY 23	There are going to be many jobs in the field of energy conservation.
DAY 24	Gas and electricity heat our homes now, but the challenge of the future will be to find alternative energy sources.
DAY 25	If everyone did their share in conserving energy then our Earth will be here for future generations to enjoy.
DAY 26	When the students bring in their utility bills they will compare cost and energy use, based on number of family members.
DAY 27	It takes a car 8,100 British thermal units (Btu) of energy to carry a person one mile. It takes a bus 3,800 Btu's of energy to carry that same person the same distance. Future transportation may conserve even greater amounts of energy.
DAY 28	All of you can make a difference. It's your world; saving it is up to you. The more people know, the more they can do.
DAY 29	Complete the ice melting activity from cahal o'coileain's article in this handbook entitled "Spiral Learning. Try it you'll like it." This activity can be found in the introductory section of his article.
DAY 30	Have students tell the whole class the 5 daily activities that they will continue to do as their share to help conserve energy.

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Keep your tires pumped 1	Count the number of light bulbs on in your house at a certain time 2	Brush your teeth using only 1/2 cup of water 3	Be a light switch policeman 4	Walk somewhere instead of having someone drive you 5	Pick up ten aluminum cans today. 6	Read a book instead of turning on the TV 7
Shut the drapes during the day 8	Open the refrigerator only five times today 9	Lower your water heater to 140 degrees Fahrenheit 10	Learn how to use your local transit system 11	Count and list the number of electrical appliances that are on in your house at 5:30 12	Take a five minute shower instead of a bath 13	Read your electric meter in the morning and then at night and calculate your usage 14
Recycle old toys 15	Collect and save sandwich bags from today's lunch 16	Do not use any battery operated devices today 17	Use recycled notebook paper 18	Eat foods vegetarian today 19	Make your own recycled paper 20	Make a future fuel from water 21
Calculate how many forms of energy you use today 22	Write a job description for a future energy you use today 23	Seek and discover an object in the classroom that could generate heat 24	Create a poster and slogan that promotes energy conservation 25	Bring in a monthly utility bill 26	Design an energy conserving vehicle for the future 27	Interview one person for ideas on energy conservation 28
List all the heat producing items in your house 29	List five ideas for possible solutions to our energy problems 30					

THIRTY DAY ENERGY CONSERVATION CALENDAR

ACTIVITY FOR DAY 13

Purpose:

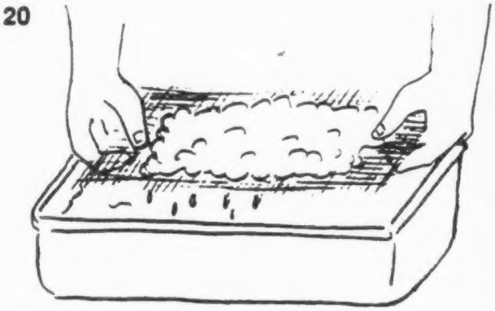
- To show how wasteful it is to leave sink water running.

Materials:

(a) Sink
(b) Stop watch
(c) Empty milk carton

Open up an empty milk carton and place it under the faucet in a sink. Turn on the faucet, and use the stop watch to time how fast the water fills up the carton to the top. Ask the class how many times a day their family leaves the water running. Ask them to predict how much water is wasted in their town every day! If the water is hot they are wasting the gas or electric energy it took to heat the water along with the energy it took to pump it out of the ground and send it into their homes.

ACTIVITY FOR DAY 20



Purpose:

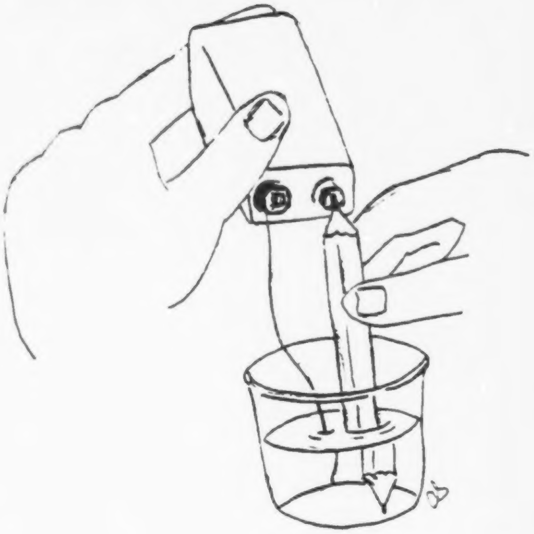
- To making recycled paper

Materials for 1 sheet of paper:

(a) Whole sheet of newspaper
(b). Extra newspapers for blotting
(c) A blender
(d) Measuring cup
(e) 2 1/2 cups of water
(f) 9" by 13" cake pan
(g) 8 1/2" by 12 1/2" window screen to fit into the pan
(h) A table or flat piece of wood

Procedure:

1. Tear up the newspaper into small pieces and drop the pieces into the blender.
2. Add 2 1/2 cups of water, cover and turn the blender on for a minute or so.
3. Pour the blended newspaper pulp into the cake pan over the screen fitted into the bottom.
4. Spread the pulp around evenly on the screen.
5. Carefully lift the screen out of the cake pan and let the excess water drain.
6. Blot the recycled paper and screen using old newspaper pages.
7. Carefully peel the recycled piece of paper off the screen and let dry fully on a table or piece of wood.
8. When the paper is fully dried; the edges can be trimmed to the standard 8 1/2" by 11" size notebook paper.



ACTIVITY FOR DAY 21

Purpose:

- To make a Future Fuel

Materials (for 4 students):

(a) 9-volt battery
(b) Small plastic cup
(c) Plastic spoon
(d) 1/2 teaspoonful of baking soda
(e) 10 cm Copper wire
(f) Pencil
(g) Water
(i) Safety goggles

Introduction:

One of the alternative fuels for future use is hydrogen. This flammable gas could power cars, jets, or heat homes. Hydrogen is not found on Earth unless its combined with other elements. The most common molecule containing hydrogen is water. In this experiment the student will use the electrical energy from a 9 volt battery to separate the hydrogen atoms from the water molecules, creating a future fuel.

Procedure:

1. Put on safety goggles.
2. Fill a plastic cup half full of water. Add 1/2 teaspoon of baking soda.
3. Wrap the copper wire around the negative terminal of the battery.
4. Sharpen both ends of an old pencil that is about the same length as the copper wire.
5. Hold one point of the pencil against the positive terminal of the battery.
6. Place the other end of the pencil and the copper wire into the glass of water containing baking soda

Predicted Outcome:

The students will see bubbles coming from both the pencil tip and the copper wire. Hydrogen gas is formed at the end of the wire and oxygen gas is formed at the tip of the pencil. Using energy to break water into hydrogen and oxygen is called electrolysis. Due to the law of conservation of energy, we know that it takes the same amount of energy to release hydrogen fuel from the water, as the amount of energy that hydrogen fuel would supply. Since electrolysis requires electricity hydrogen is not an efficient fuel to make for daily use. Scientists are hoping to mine pure hydrogen gas from other planets or moons in the future. Someday solar energy may also be used to produce hydrogen fuel.

WHAT PRODUCTS OR ACTIVITIES USE THE MOST ENERGY?

ACTIVITY FOR DAY 22

Most of the activities that we human beings are involved in require energy. Not only is biological energy necessary to run our bodies, but other forms of energy are needed as well. Guess what activities you think use the most energy.

DIRECTIONS:

Listed below are activities or uses of energy. Rate these by checking the appropriate column(Low, High or Unknown.) After completion, compare answers with the class, and find out what activities require the most energy.

ENERGY USE	Low	High	Unknown
1. Washing pots and pans by hand instead of using a dishwasher			
2. Taking a bath instead of a shower			
3. Watching a black and white TV instead of watching a color TV			
4. Washing one load of laundry a day instead of doing your laundry once a week			
5. Driving in a car instead of riding a bicycle			
6. Flying in a plane instead of taking the car			
7. Keeping the thermostat at 80 degrees in the summer instead of 85 degrees			
8. Eating at a "fast food" restaurant instead of at home			
9. Sleeping in a heated water bead instead of using a heavy comforter			
10. Driving your car at 65 mph instead of 75 mph			

After the students have completed their month long conservation calendar, they will become more aware and more likely to be conservers. Apart from becoming efficient energy conservers, the students will have learned how to:

1. graph different statistics
2. compute different statistics
3. recycle paper
4. read an electric meter
5. use their local transit system
6. experiment with electrical energy
7. solve problems concerning future jobs and future transportation
8. read a utility bill

This calendar exposes the students to thirty different ways to conserve energy. By becoming aware of our energy problems, students will be more willing to conserve energy for our future use.

SUGGESTED ADDITIONAL READINGS

Bender-Keigler, J. (1989). Quick energy and beyond: ideas for the 90's. Estes Park, CO: Colorado Energy and Resource Educators, Inc.

Cannastra, R. (1987). Energy sourcebook V: electricity '87. Washington, D.C.: Edison Electric Institute.

Editor, et. al. (1989). Quick energy for elementary teachers. Salt Lake City UT: National Energy Foundation.

Javna, J. (1991). Fifty simple things kids can do to save the Earth. New York, NY: Scholastic, Inc.

TO ACT OR NOT TO ACT: SOCIAL ACTION IN THE CLASSROOM

(Grades 7-8)

By olivia free-woman

Mass media has made its way into the classroom. While Whittle Communications has its Channel One with eleven minutes of news spliced between two commercial breaks piped into the classroom, CNN offers fifteen minutes of commercial-free news over its cable education system. Newspapers and magazines offer everything from teaching units on specific topics to special publications for the classroom.

But all of this awareness of current events, news spots on oil spills in Alaska, close-up coverage of the riots in Los Angeles, and reports on the holes in the ozone layer over the polar regions, means little to a population that can not see what, if anything, they can do about the world around them. An informed public is essential to a free society. But an informed public that lacks the skills and know how on how to act with that knowledge is a disenfranchised public.

Teaching students to be responsible citizens means not only teaching them to be politically and socially aware, but also to be politically and socially active. It means providing students with the opportunity to take action, to use the knowledge with which we provide them to accomplish some end beyond a score on the district or state test of teacher accountability. It means taking students' minds out of the classroom and, sometimes, into the streets.

But the idea of taking on social action as a classroom project can seem overwhelming to an already overextended teacher. With deadlines to meet, outcomes to reach and administrators to appease, it is essential to make such an endeavor as easy and as comfortable as possible. The information contained in this article outlines the steps to follow. It is hoped that this outline will provide that ease and comfort.

Remember: ***Taking action does not mean changing the world.***

All it means is doing ***something***.

WHERE TO BEGIN: IDENTIFYING AREAS OF INTEREST

Begin at the beginning . . . by helping students identify problem areas in which they are interested. Social action projects can spin off from almost any activity in any subject, from a discussion in an advisor/advisee activity, a story read in literature or an assignment in science or social studies. Activities such as brainstorming can be useful in helping students identify areas of interest and concern.

As topic lists are generated, most students will identify subjects that are of importance to them. Other students may need help in pinpointing their areas of concern and may not realize they even have an opinion until they find themselves taking one side or another on an issue.

Other students may still be "hold-outs" expressing a laissez-faire attitude. These students may well choose to simply go along with their friends. Such an attitude is acceptable. The point of taking social action is to teach students that they can make an impact on the world around them. As the activity progresses and students begin to realize this, the opinions these students have, or don't have, will become more significant to them.

Let's say that the class has just completed a math activity in which they found the volume of a Styrofoam® container. The activity is then expanded to finding the volume of a variety of containers, such as pizza boxes, jars, pop cans, milk jugs, paper sacks, etc.

Discussion is then directed to container choice and the pros and cons of a variety of container qualities such as reusability, insulation qualities, manufacturing costs, disposability, and cost to the environment.

Through discussion students are guided into taking sides over such issues as paper sacks vs. plastic bags, glass bottles vs. plastic jugs, and laws mandating such things as container deposits or recycling.

From the lists of topics identified, student groups or the class as a whole can now choose a topic on which to take a position and to explore further. In this article, we will look at one topic: the use of Styrofoam® dishes in the school cafeteria.

IDENTIFYING KNOWNS AND UNKNOWNS

Once students have taken a position on a topic, the next step is finding out what they already know and what they don't know about it. A simple two column chart can help.

In the first column, have students list all the information they know to be absolutely true about their chosen topic. These facts may be as general as "Styrofoam® is a problem" or as specific as "Styrofoam® is a hazard to wildlife that ingests it and then can't digest it." But all the information listed in column one must be known to be true. If students disagree about whether or not a statement is a fact, then it should be listed in column two.

In the second column, students are to list any statements they aren't sure are true and any unknowns they can identify. These "unknowns" are most easily understood as questions, although they don't have to be. Often, statements listed in the Knowns column will generate questions for the Unknowns column.

Topic: The use of Styrofoam® dishes in the school cafeteria

Position: The cafeteria should use dishes that can be washed instead dishes made of Styrofoam®

KNOWNS

Styrofoam® is a problem
Styrofoam® doesn't rot
Styrofoam® is used by fast-food restaurants
Styrofoam® keeps food hot
Styrofoam® is harmful to fish and birds that eat it
Dishes can be washed and reused
Detergent pollutes
Heating water uses energy

UNKNOWNS

Can Styrofoam® be recycled?
Does the production of Styrofoam® pollute the environment?
Which costs less, buying Styrofoam® or washing dishes?
Are there detergents that are less polluting?
The cafeteria already washes silverware
Which uses more energy, making Styrofoam® or sterilizing dishes?

The "Knowns" column provides the basis of information upon which students will develop their plan of action. But before that can happen, items in the "Unknowns" column need to be resolved.

WHO MIGHT KNOW THE UNKNOWNS?

Who might know the unknowns does not mean specific people or agencies. Instead, it is a list of the type of places to which one might turn to find the answers. This general list might include businesses, manufacturers, governmental agencies, utilities, parents community resources, and even staff on campus.

This information is student-generated. Through their own discussions or brainstorming, students list what kinds of people or places might know or have the answers to their unknowns.

Can Styrofoam® be recycled?
- a recycling company
- the city trash company
- a company that makes Styrofoam®

Does the production of Styrofoam® pollute the environment?
- a company that makes Styrofoam® .
- the public library
- governmental agencies

Which costs less, buying Styrofoam® or washing dishes?
- the school cafeteria
- a company that makes Styrofoam®

Are there detergents that are less polluting?
- a company that makes detergent
- a company that makes dishwashers
- a water treatment plant

The cafeteria already washes silverware
- the school cafeteria

Which uses more energy, making Styrofoam® or sterilizing dishes?
- a company that makes Styrofoam®
- the public library
- the electric company

RESEARCHING RESOURCES

This step is as simple as using city phone books and directories to locate the names of specific companies and agencies that were identified in the last step and to find out their addresses and phone numbers. When this step is completed, every unknown should have at least one place or person associated with it to which students can turn to find the answers they need.

The following information card will help students gather the information they need to know before they can contact a source.

Resource Information Card

Unknown: ______________________________
____
Type of Resource: ______________________________
Name of Company/Agency: ______________________________
Name of Contact Person: ______________________________
Street Address: ______________________________
City, State, Zip: ______________________________
Phone Number: ______________________________

Have students transfer their list of Unknowns and types of resources to the information cards, putting one Unknown and one resource type on each card. Students can now divide up the cards and research the resource information. They will undoubtedly return with the names and addresses of some of the same resources. These cards should be stapled together for use when going to the source.

GOING TO THE SOURCE

In most states, the list of essential skills students are to expected to acquire in school include areas of written and verbal communication. Students are expected to be able to write formal business-type letters and to verbally communicate a variety of information by the time they exit elementary school. Gathering information from various sources affords students the opportunity to develop and use these skills in a meaningful situation beyond the four walls of the classroom.

When gathering information, whether in writing or on the phone, students need to communicate three basic areas of information: Who they are and why they are contacting the person, what information they desire, and their appreciation of the person's time.

The following template or model can help students in composing their formal letters:

School Street Address
City, State Zip
Date

Person's Name
Company's Name
Company's Street Address
City, State Zip

Dear (or To Whom It May Concern):

In paragraph one, tell who you are and why you are writing. This means telling the name of your school, your grade and something about the school project on which you are working.

In the second paragraph, request the information you would like to have. This request may be in the form of questions you would like to have answered, such as, "I would like to know, can Styrofoam® can be recycled ? If it can, what kind of things can be made from it?" Or your request might be statements identifying information you would like to have sent, such as, "We would very much appreciate any information you could send us on recycling Styrofoam® and the products it can be recycled into."

Your last paragraph should thank the person for taking the time to read your letter. You should also thank them for any information they will be able to send to you.

Sincerely,

Your Name

A guide for making phone calls would essentially follow the same format:

Phone Call / Interview Guide

Remember: Be prepared. Write out your questions ahead of time. Have paper and pencil with you to take notes. Have the school address and phone number ready in case you need to give it to them.

1. Introduce yourself: Hi. My name is ____________________ and I
am a ______________ grade student at ________________________
___________________ school. I am doing a project on _______________
_____________________________________ and am hoping you might be
able to help me with some information I need.
If you are transferred to another person, start with number one again.

2. Ask your questions: Ask one questions at a time. Let the person know you want to record the information accurately and ask them to repeat their answer, if necessary. Record your answers on the Interview Record Form.

3. Thank the person for his or her time: For example, "Thank you, Mr. or Ms. Who Ever. I really appreciate your help."

Time is Money in business. Keep your questions short and to the point.

Face to face interviews would follow a format similar to that of a phone call. If the interview is with a school staff member, a difference would be that students may not need to identify the name of their school, but would need to identify the name of their teacher.

When information is gathered verbally, whether over the phone or in person, students need all the help they can get in making sure they record that information accurately. The following is a suggested interview record form. Students should complete as much information as possible before contacting their resource and take it with them along with the Phone Call / Interview Guide.

Interview Record Form

Date: ____________________________ **Time:** __________________
Name of person: ____
Title or Position: ____
Name of Company: ____
Question 1: ____
____
Answer: ____
____
____
____
____
____
____

The Interview Record Form should include space for up to four questions.

MERGE NEW INFORMATION WITH KNOWN INFORMATION

As student requests for information are answered, students will need to amend their lists of Knowns and Unknowns. Questions under the Unknowns heading should begin to disappear and information under the Knowns heading should increase. As before, new information may raise new questions, in which case students would need to again identify who might be able to answer these new Unknowns and to seek out that information.

There will come a point when Knowns outweigh Unknowns and students have enough information on which to act. Based on what they know, their decision becomes what action to take.

DECIDING ON A COURSE OF ACTION TO TAKE

There are five basic levels of social action. They are: Raising Awareness, Calling for Change, Grass Roots Organizing, Forcing the Issue and Civil Disobedience. Each level of action includes the level preceding it. In other words, you can't call for a change without raising awareness and you can't force an issue without raising awareness, calling for a change and grass roots organizing.

Take the example of the use of Styrofoam® in the school cafeteria: What can students do about it?

RAISING AWARENESS

Raising awareness means calling attention of the powers that be to the information that has been gathered. This level is utilized when someone is not sure what course of action is possible to correct or respond to a situation or when you want additional information from those in power.

In the case of Styrofoam® use, letters written by students to appropriate school and district personnel could explain the facts surrounding the issue and express students' concern. Students might decide to present the information in person at a school board meeting or in a meeting with the principal or cafeteria manager.

CALLING FOR CHANGE

Life would be a breeze if all we had to do was call attention to a problem for it to be resolved. If a raised awareness was all that it took, classes would have no more than 18 students in them, schoolrooms would all be equipped with laser disks and computer terminals, and teachers wouldn't consider a pencil found on the ground a treasured prize.

But such is not the case and those in power often need to be told not only that there is a problem, but also what they should do about it.

Fortunately, once people have raised their own level of awareness, they usually know what it is they would like to have happen in order to correct a situation. When this is the case, information is presented to those in power not only to raise their awareness, but also to convince them that the suggested change is possible and desirable.

Rather than writing letters or making presentations to simply inform the principal, the school board, or whoever as to the hazards of Styrofoam®, students would also request that the use of Styrofoam® be halted and the use of reusable dishes substituted in its place.

GRASS ROOTS ORGANIZING

Sometimes more is better. Grass roots organizing is the process of strengthening your position through sheer numbers. The goal of grass roots organizing is to raise the awareness of the community in general and, in doing so, garner support for the change you are requesting. It can entail letters in school or community publications, information tables at lunch or open house, posters, flyers, pamphlets, speeches and word of mouth.

Actions, whether they are posters students make or letters they write to the editor, should encourage others to contact the powers that be and call for the identified change. The easier activists make it for others to take action, the more likely it is that they will do so. The sharing of information on how to contact those in power is an important part of grass roots organizing.

FORCING THE ISSUE

Forcing the issue isn't as drastic as it sounds. In the "real world" it includes such things as workers picketing a factory, rallies at the state capital, recalling elected officials and circulating petitions concerning particular issues. It means pulling your grass roots forces together in a show of strength to convince those in power that there is popular support for the change you are requesting.

Petitions are one of the easiest ways to organize others into showing their support for an issue. The circulation of a petition allows students to share their information directly with others and to immediately enlist their support.

There are other actions which also demonstrate support. Demonstrate is the operative word here. To protest the use of Styrofoam® in the cafeteria, students might organize a "Bag It Day," a day when students (and staff) bring their own lunch rather than buy lunch from the cafeteria. Or students might save the Styrofoam® their meals come in and build a Liberate the Earth from Styrofoam® statue. Arm bands, buttons and anti-Styrofoam® skits are all possibilities, as long as they stay within school rules of student conduct. Actions beyond these boundaries are acts of civil disobedience.

SOME NOTES ON CIVIL DISOBEDIENCE

In most cases, most people would probably say that civil disobedience does not belong in the classroom, that education should not be in the business of encouraging students to break laws or rules. It might help to take a closer look at what civil disobedience is.

First, a definition. For the purposes of this article, civil disobedience means nonviolent activities that do not include the destruction of property. This immediately leaves out such actions as the Boston Tea Party. In general, civil disobedience means an action that is known to be against the established laws or rules of order and that is committed for the purpose of changing some aspect of that establishment. This includes the sit-ins at segregated lunch counters during the sixties, the refusal to pay taxes in Colonial America, and the Underground Railroad which helped slaves escape to freedom in the North. All of these actions were contrary to the established laws of the times. Each was an act of civil disobedience.

Civil disobedience has been evident in public education. In 1965, a 13-year-old girl, her older brother and a friend wore black arm bands to school to protest the Vietnam War and refused to remove them when instructed to do so. As a result, the three students were suspended. Four years later, the United States Supreme Court issued its ruling in Tinker vs. Des Moines, stating that symbolic speech, such as the arm bands worn by the students, was protected under the First Amendment guarantee of freedom of speech. The suspensions, the Court ruled, had been illegal.

In 1992, a seventh-grade student in Phoenix, Arizona refused to honor a school rule banning attire displaying certain sport insignias. The insignias had been identified by authorities as possibly being associated with gang activity. When the student arrived at school wearing a tee shirt sporting a Chicago Bulls emblem, he was sent home. The final result of this action is still pending.

It is probably not wise to suggest that teachers instigate students to become involved in acts of civil disobedience, but it is important for students to understand the role such actions have played in our history and are playing in our society today.

EVALUATE THE ACTION

Evaluation of a social action allows students and teachers to more fully realize the impact they are having on their community. It enables them to identify the effect the action has had and to decide if additional action is warranted and something they are interested in pursuing. Since the purpose of taking social action is to demonstrate to students that they can impact the world around them, it is important to focus the evaluation on the positives.

EVALUATING RAISING AWARENESS

Evaluation of this step would be based on the school's response to the letters or verbal presentations. Recognition that students were heard by those in power, e.g. a letter thanking the students for their concern and informing them that the use of Styrofoam® will be investigated, may be all that the group needs to hear.

If new information is gained from the responses, such as a lack of dish washers in the kitchens, this action could lead back to Identifying an Area of Concern or Identifying Knowns and Unknowns. Students may follow up by researching sources and seeking additional information on the cost of using paper plates and then presenting this information to the school.

EVALUATING CALLING FOR CHANGE

Again, the response from the school would be the foremost criteria in the evaluation of this step. If the cafeteria reduces or eliminates its use of Styrofoam® , obviously the students were successful. If the feasibility of such a plan is to be investigated or is put on the agenda for consideration at some point in the future, again the action was successful. If students are not satisfied with the response they receive, if they are ignored or dismissed, they may decide to take their concerns to the next level of action.

EVALUATING GRASS ROOTS ORGANIZING

Surprisingly, success at this level does not necessarily depend on the actions of those with the power to make a change. Since a goal of grass roots organizing is to educate the community, success comes with raising the awareness of people in general. Additional success is achieved if those people act by expressing their desire for a change.

Keep in mind, evaluation at all levels is very subjective. If students feel they have made an impact, no matter how small , then they have succeeded.

EVALUATING FORCING THE ISSUE:

Again, the sudden elimination of Styrofoam® would indicate complete success, but any move in that direction, even the acknowledgment of the students' concerns, is a victory.

The following is an example of how the Styrofoam® issue could progress through the first four levels of social action.

RAISING AWARENESS

Action - letters to the school board expressing concern over the use of Styrofoam®

Reaction - the school board writes back with a thank you very much, but we're not interested

Evaluation - the students need to inform the board as to alternatives; students research and seek out additional resources and information to present to the board

CALLING FOR CHANGE

Action - letters to the board identifying alternatives, including paper plates and washing dishes

Reaction - the board replies that they are pleased the class is learning to write letters, but a change isn't a good idea at this time

Evaluation - the board needs to know this isn't just a class project and that other people are concerned as well

GRASS ROOTS ORGANIZING

Action - students make posters about the danger Styrofoam® poses to wildlife and write an article for the school newspaper about how Styrofoam® is contributing to the pollution of the environment; students agree to each ask three friends to write letters to the school board

Reaction - a school board member visits the class and suggests students write letters to a fast food restaurant about their Styrofoam® use since the school uses considerably less Styrofoam® than the restaurant does

Evaluation - the board still doesn't realize just how concerned the students are; they need to help the board understand this

FORCING THE ISSUE

Action - students write up a petition and decide to circulate it among students, staff and parents; they set a goal of 300 signatures

Reaction - the school board decides to investigate other possibilities rather than just Styrofoam® use, but inform the students they will not be able to make a change until the next fiscal year

Evaluation - the board and the school community are aware of the dangers that Styrofoam® poses for the environment; the board is willing to at least consider alternatives

If students can see the impact of their actions, they may be satisfied to not take additional action. But social action can lead to ongoing activities too. Paper recycling projects, food bank adoptions, classroom gardening plots are all ongoing actions that could become part of the regular school program.

CONCLUSION

The rain forests are not going to be saved, world hunger will not be ended and homelessness will not be eliminated by what students do in a classroom. But if these issues are to be resolved, it will be because the students we teach today act tomorrow. As teachers, it is our responsibility to empower our students, to equip them with the skills they will need as well as instill in them the belief that they can make a difference.

KNOWNS AND UNKNOWNS

Topic: ______________________________

Position: ______________________________

____

Knowns	Unknowns

RESOURCE INFORMATION CARD

Unknown: ______________________________

____

Type of Resource: ______________________________
Name of Company/Agency: ______________________________
Name of Contact Person: ______________________________
Street Address: ______________________________
City, State, Zip: ______________________________
Phone Number: ______________________________

RESOURCE INFORMATION CARD

Unknown: ______________________________

____

Type of Resource: ______________________________
Name of Company/Agency: ______________________________
Name of Contact Person: ______________________________
Street Address: ______________________________
City, State, Zip: ______________________________
Phone Number: ______________________________

PHONE CALL/ INTERVIEW GUIDE

Remember: Be prepared. Write out your questions ahead of time. Have paper and pencil with you to take notes. Have the school address and phone number ready in case someone asks for them.

1. Introduce yourself: Hi. My name is ______________________________
and I am a ____________ grade student at ______________________________
school. I am doing a project on ______________________________ and
was hoping you might be able to help me with some information I need.

If you are transferred to another person, start with number one again.

2. Ask your questions: Ask one questions at a time. Let the person know you want to record the information accurately and ask them to repeat their answer, if necessary. Record your answers on the Interview Record Form.

3. Thank the person for their time: For example, "Thank you, Mr. or Ms. who ever. I really appreciate your help."

Time is Money in business. Keep your questions short and to the point.

INTERVIEW RECORD FORM

Date: ______________________ Time: ______________

Name of person: ______________________

Title or Position: ______________________

Name of Company: ______________________

Phone Number: ______________________

Question 1: ______________________

Answer: ______________________

Question 2: ______________________

Answer: ______________________

Question 3: ______________________

Answer: ______________________

Question 4: ______________________

Answer: ______________________

Thank the person for their time!

WANTED: SOCIAL UNREST AND HOSTILE TAKEOVERS IN THE CLASSROOM

(Grades 7-8)

By olivia free-woman

INTRODUCTION

Social unrest and hostile takeovers are not the typical goals of classroom instruction. The cooperative classroom with the enlightened teacher spurring students onward to critical thinking while maintaining a calm learning environment is much more to the liking. But every now and then, a wrench tossed into the works can provide students with the opportunity to experience their own power to bring about change.

Economies in schools and classrooms are frequently used to reinforce computation skills, demonstrate practical application of math concepts and to teach principles of economics. But therein also lies the mechanism to teach lessons in social action and inaction.

An economic system is to be established in a middle school math class. It's primary objective is the reinforcement of math concepts through practical application in near true-to-life situations. In walks the company CEO (the teacher or friend thereof, appropriately dressed in a three-piece suit complete with attaché). The CEO announces the birth of SMITH AMALGAMATED: an international conglomerate offering services in accounting, problem solving, computation, design, and technical drawing. And SMITH AMALGAMATED is hiring. Salaries, of course, will be based on each individual's experience, skills and level of education completed.

Applications are filled out, students produce "diplomas" declaring the level of education they have attained, salaries are established and SMITH AMALGAMATED is on its way.

Pay checks are given out, minus taxes and Social Security. Rents and utilities are paid and checkbooks balanced on a regular schedule. There are bonuses for perfect attendance and fines for late work and minor rule infractions. And purchases that can be made: the prize seat in the classroom, a skipped homework assignment, a front of the line lunch pass, even stock in the Company. And, there are the required weekly checks for "groceries."

The program progresses and, as the class becomes comfortable with it, students begin to "move up" in the Company and take over its operation.

The business manager cuts the pay checks, the property manager collects the rents, and the utilities coordinator collects the bills (SMITH AMALGAMATED owns everything, of course). There is even a banker and clerks to cancel checks, make out bank statements and issue loans.

It is at this time, when all is calm and the hum of the economy can barely be heard beneath the din of daily lessons and activities, that the wrench can be tossed.

Re-enter the suited CEO to announce a down turn in the economy and the misfortunes of ill made deals. SMITH AMALGAMATED is in deep financial trouble and, sad as it might be, drastic actions must be taken.

Discontent begins to brew when salaries are cut. Then rents go up and the cost of utilities increase and cries of "unfair" and "you can't do that" are heard. Social unrest is on the rise.

As students begin to question the fairness of the actions taken by SMITH AMALGAMATED, they will also begin to identify whether or not they think they can do anything about it. Some may acquiesce and not even verbalize their complaints. Some may "talk big" but still go along with the flow. Others will begin to formulate plans of action.

All will most likely need some guidance as to what can be done, but forbid such guidance should come from the Company management.

Other teachers, staff and parents, enlisted beforehand or sought out by students, become vital resources. These *outside agitators* can guide students into identifying the types of action they could take to register their complaints with the management and maybe bring about change.

Thematic units can facilitate the process. Studying various social and political movements in history, reading the biographies and writings of American activists, presenting speeches by or plays about various activists provide students with role models of those who saw injustice and acted to change it.

Students can be guided into traditional forms of protest. Petitions could be written outlining their grievances, letters of protest could be sent to the management, pickets could be held outside the classroom, fliers could be distributed publicizing the situation, or strikes could take place in the classroom with students quietly refusing to participate in the lesson.

And then there are the more creative forms of protest. Students could stage a "sit in" at the teacher's desk. Homework assignments could be completed in secrete code or with all the problems and answers written backwards. Or students could decide to all wear the same color in a show of solidarity.

Every action, no matter how traditional or non-traditional, would require organization, planning, discussion, compromise and cooperation on the part of the students as well as their basic belief that they have the power to effect change.

And change - the ultimate willingness of the management of SMITH AMALGAMATED to sit down, discuss grievances and back off from some of their unpopular decisions - teaches the final lesson: People do not have to acquiesce to situations they perceive as unfair or unjust. Individuals can make a difference.

Through discussions of the activity, on the premises of SMITH AMALGAMATED (the math class) or as part of another class, students can analyze and evaluate the activity. They can compare their experiences with the real world. They can examine the success or failure of their various actions as well as look at what actions have actually resulted in changes in society. They can talk about the consequences of different political and social actions, the meaning of civil disobedience, the reactions of government and law enforcement, and the reactions of society at large. And they can identify situations in the school or their community that they feel are unfair and the actions they can take to rectify them. In doing so, students will learn that every individual has the power to, at the very least, begin the move towards change.

POSSIBLE COMPANION UNITS OF STUDY

American Indian Movement (A.I.M.)
American Labor Movement
Civil Rights Movement
Hay Market Riots
Suffrage Movement
United Farm Workers Movement
Viet Nam War Protests
Women's Peace Encampment - Seneca Falls, NY.

ADDITIONAL ACTIVISTS FOR POSSIBLE COMPANION STUDY

Alice Paul
Cesar Chavez
Dolores Huerta
Ida B. Wells Barnett
Margaret Kuhn
Margaret Sanger
Martin Luther King
Mother Jones
Rosa Parks
Ryan White
Samantha Smith
Sojourner Truth

SUGGESTED ADDITIONAL READING

Eckert, A. (1992). A sorrow in our hearts: The life of Tecumseh. New York: Bantam Books.

OTHER MATERIALS

The Trial of Standing Bear (Video - Public Broadcasting Service).
The Trial of Susan B. Anthony (Play - Edited by Dianne Post. Available from Lavendar Patch, Inc., 1826 E. Willetta, Phoenix, AZ 85006).

THE FOLLOWING MATERIALS ARE AVAILABLE FROM THE NATIONAL WOMEN'S HISTORY PROJECT

BOOKS

Black Woman Makers of History: A Portrait by George F. Jackson.
Chief Sarah: Sarah Winnemucca's Fight for Indian Rights by Dorothy Nafus Morrison
Fannie Lou Hamer by Susan Kling
The Montgomery Bus Boycott and the Women Who Started It by Jo Ann Gibson Robinson
Vilma Martinez by Corinn Codye

ADDITIONAL MATERIALS

A Salute to Historic Black Women (pamphlet-Dorothy M. Love, ed.)
How We Got the Vote (video-Republic Pictures)
"Vilma Martinez" (unit of study by Bonnie Eisenberg)
"Women Suffrage Movement 1848-1920 (unit of study by Bonnie Eisenberg)

National Women's History Project
7738 Bell Road
Windsor, CA 95492-8518

WEATHER AND THE WATER CYCLE: AN EXPLORATORY UNIT WITH CROSS-CURRICULUM EXTENSIONS

(Grades 4-6)

By Teresa Olson and Valerie Grimes

INTRODUCTION

According to Robert E. Yager in his 1990 article, "STS Thinking Over the Years, an Overview of the Past Decade," the science student who has regularly participated in STS science instruction will benefit more from their instruction than science students from a more traditional science instruction background. These students' curriculums have been distinguished by studies better relating to their daily life. Their classes focus on problems of local, national, international, and personal relevance. Students are actively involved in seeking information through the use of local resources.

Students in Val Grimes' 4th grade classroom participated in a unit exploration of properties of matter, the water cycle, and weather that exemplifies this type of instruction. As Val and I discussed this unit, I was struck by the interesting variety of activities allowing for a great deal of cross curriculum instruction. We also decided to add new modifications to strengthen the unit. So although most of the unit has been 'student-tested' for success, it is a work in process, meaning that new modifications are planned. Any new ideas that haven't been tried out will be marked as "Sug. Mod."-meaning suggested modification. Val kicked the unit off with an exploration of the properties of matter.

THE DANCE OF THE MOVING MOLECULES

A display was set up with a glass of ice water, boiling water, melting ice cubes, and room temperature water in a glass. Explanations and definitions of matter and molecules were given.

(Sug. Mod.) Give each student a piece of scrap paper. Ask them to tear it in half once, twice, three times. Have them tear it in half again and again, until the remaining piece is too tiny to tear again.. Explain that if you could somehow tear it down into the smallest bit possible that would still be paper, that would be a molecule.

Val called half of the class up to the front of the room. The other students were asked to watch and get ready for their turn. The teacher cues went like this:

"Now first, you are going to be molecules of an ice cube. You are very cold, so you aren't moving very fast. You are vibrating some, but you are jam-packed together. That's right, push close together, so close I can't even get my hand in between, you aren't moving away from each other, just vibrating some.

"Oh, dear! I've been forgetful, and left the ice cube tray on the counter, so now the ice is melting into water. Now, as a liquid, you are starting to move away from each other, rather slowly, but you are still pretty close together. You are moving around more than you did when you were an ice cube. It's a lot easier to get my hand in between you!

"Oh no! Mom saw that I left the ice cube tray out! She's decided to make hot tea with the melted ice water. Now you are on the stove. You are getting warmer, so now you are moving around faster. Move around a little faster, because you're getting warmer still, in fact you're getting so fast, you are flying around the room! You got so warm you are evaporating! These water molecules are flying all over the room!

"Now I need someone to play my part, and give the speech that tells what the molecules are doing, while the other half of the class acts out the Dance of the Moving Molecules. Who will volunteer? OK, let's go!"

After several students had an opportunity to direct the Dance of the Moving Molecules, composition blue books were passed out to be used as concept logs. Students reviewed the concepts behind the activity. They had learned the meaning of matter, molecules, and the behavior of molecules when they are in different states of matter. They were coached on data gathering.

Now Val asked the students if they had noticed the ice water on the front table. Then she asked them what was different about it now, after it had been sitting out for a while. When a student volunteered that it now had water droplets on the outside of the glass, she asked if anybody knew why? Where had that water come from? Students answered that they had somehow come from the water that has evaporated in the air. Now students were ready to learn the vocabulary word condensation. They discussed it and added it to their concept logs.

THE WATER CYCLE

Some of the students were already familiar with the water cycle from studies in the third grade, but many were not. Now they were ready for the lesson on the workings of the cycle, and Val taught a basic lesson on the relationship between evaporation, condensation, and precipitation. She used overhead transparencies and filmstrips available from the district's media center. Students added these words to their concept logs.

INDEPENDENT STUDY

Students were told that they should get into small groups of between 4-6 people. They were to choose a particular area about weather for research and study. They would then develop something which they could present to the class. The requirements were left open, to allow for maximum student freedom and responsibility. Students were allowed about 1 hour a day, 3 times a week to develop their units. Sharing time was worked into the class curriculum as the students finished their units, rather than appointing a pre-set date of completion. Val felt that watching what the other students had completed, and seeing their presentations, was a motivational factor to the more reluctant or less prepared students.

Students were taken to the school library, where the librarian had displayed a variety of weather resources. This helped the students to begin to focus in on a topic. Some of the student choices were as follows:

1. Weather Lore: This group produced and presented a book summarizing their research into the truth and fallacy of common weather myths such as, when sheep bunch together in a field, it means a storm is coming soon, or rings around the moon, rain is coming soon.

2. Rainbows: This group studied the physics of why they form and the aspects of different colors of light.

3. Vocabulary: This group made a word puzzle out of the unit's vocabulary.

4. Weather Station: This group found directions for, collected supplies for, and built a weather testing and recording station. Naturally, its station was located outside, and it was unfortunately available to thieves. This lead into a values lesson on stealing, and its repercussions.

5. Volume of Air: This group used an air pump and an air mattress to measure air volume.

6. Thunderstorms and Lightning: This group made a wall mural that contained artwork and factual information that they had researched.

7. Personal Experience: This group interviewed a relative of one of the group members about his experience of being caught in a tornado.

EVALUATION

After each group gave its presentation, Val handed out short evaluation forms to all students. In this way, each group heard from all of the students, as well as the teacher. The evaluation questions were:

What was this presentation about?
What did it mean?
What part did you enjoy the most?
Why did they choose this?
Any suggestions for refinement?

CROSS CURRICULUM CONNECTIONS

Language Arts: Spelling words were taken from the unit to reinforce their retention. Val read two books aloud to the children about intense weather conditions. In the Night of the Twisters, a true story, a town was struck with 7 tornadoes in one night. In Voyage of the Frog, Gary Paulson tells about a boy who is blown off course in the ocean during a storm. The children's concept logs were also a good writing experience.

Art: The Art teacher developed a 'weather art' lesson early in the unit, and these pieces were on display in the classroom.

Math: (Sug. Mod.) It would be useful to set out a 1000 ml. graduated cylinder full to the 1 liter mark on the first day of school. If there was a matching wall chart with milliliter demarcations, the students could chart the amount of evaporation which occurred each day. They would learn several things from this experience including how to read a graduated cylinder, how to record data on a regular basis, and averaging the daily loss.

The practice of reading the graduated cylinders could lead to a lesson dealing with reading thermometers, one of the expected academic objectives for students of the fourth grade. You could easily construct a boiling point experiment that would accomplish this goal, and blend in well with the water cycle lessons.

Careers: A meteorologist from a local TV station came and spoke to the children. He discussed the ins and outs of his, and other occupations associated with the weather. He stressed the value of education in achieving expertise in this area.

Field Trips: When the students visited the Science Museum in the spring, the docent had an activity planned to demonstrate properties of liquid nitrogen. When she asked the students what molecules did as they warmed up, even though it had been seven months since the lesson, these students knew!

CONCLUSION

The length of the unit was approximately one semester. The original lessons about the properties of matter and the water cycle were covered in two weeks. There were other topics and lessons during the semester, but allowing the students needed time for exploration increased student retention of concepts, as well as their involvement and excitement in the topic.

SUGGESTED ADDITIONAL READINGS

Paulson, Gary. (1990). Voyage of the frog. New York: Dell Publishing Co., .
Ruckman, Ivy. (1986) Night of the twisters. Harper-Collins Children's Books, New York: Harper-Collins Children's Books
Yager, Robert E. (1990). STS Thinking Over the Years-An Overview of the Past Decade.The Science Teacher, 57(3), 52-55.

WE'LL NAME IT LATER

(Grades 4-8)

By Gerald Dameon, Douglas A. Freeman & Lynn Piwowarczyk

INTRODUCTION

A key ingredient of STS is the notion that true learning does not take place in isolation but rather across the broad spectrum of curricula. Students gain a more complete understanding of topics or issues when they are able to view them from a multifaceted approach. No topic in today's complex society is without far reaching effect into many areas. Since problems are interrelated to other components in the world, so must be our approach to education.

In these pages, we create a realistic teaching activity, whereby a problem brings into play several topics of instruction. Students utilize modern technology to solve a problem. They gain a better understanding of the complexity of economics and the competitiveness of industry. Students keep a video journal of themselves and their classmates using problem solving methods to create a model product that can be used to solve a problem. The prototype product is then marketed and advertised to the public (other classes).

Many different problems could be studied using this same format. The problem is as important as the process that students experience in creating and marketing a solution. More than enlightening the students to problem solving, we are empowering them to become involved and take action. Enhanced self-esteem becomes a byproduct when students successfully utilize science and technology in the process of solving a problem.

At the culmination of this activity, a copy of the video tape may be made available to each student. This tape might serve as a source of pride and can be shared later with friends and family.

Objectives:

Students will . . .

1. Learn to use audio visual technology
2. Apply computer technology
3. Learn and experience the problem-solving process.
4. Use propaganda techniques
5. Experience the free enterprise system
6. Solve a problem cooperatively
7. Practice public speaking skills
8. Build their self-esteem

Materials:

(a) TV
(b) VCR
(c) Video cassette tape for each team
(d) Construction materials e.g. construction paper, boxes, scissors, hangers, plastic containers, etc.
(e) Several pieces of tagboard (for cue cards)
(f) Markers

STUDENT PREPARATION

Student preparation is of the utmost importance for this activity. Most students find themselves involved in this project with no previous experience. Assimilation of content by the entire class can help to ensure a coherent and complete learning experience. Learning the broad base of information allows students to better conceptualize the project and fosters a sense of ownership of both the process and the end product.

For this activity, there are at least two teams. Each team competes to market a product they invent. Each team, or company, is divided into the following groups:

A) Video
B) Engineering/Construction
C) Advertising/Marketing

The following outlines the roles for the members of each group. Students should be reminded that each role in the group is as important as another. and that the group, not the individual, is responsible for the end product.

VIDEO

All members of the video group must participate in the making of a video journal and advertisement. The following responsibilities are specific tasks for each role.

1. Camera person - Sets up, operates, and tears down video camera and equipment.
2. Interviewer - prepares investigative questions and conducts interviews.
3. Director/Editor - guides the camera person and the interviewer. He or she is responsible for the quality of the production.

ENGINEERING/CONSTRUCTION

All members of the engineering/construction group must be involved in the design and assembly of the product. Each role, however, has its own specialized responsibility.

1. Lead Engineer - keeps group on task and is responsible for final design.
2) Draftsperson -creates a professional drawing or design of the product to be manufactured.
3 Liaison - keeps lines of communication open between designers and assemblers.
4. Foreman - is responsible for assembly of product as the engineers designed it.
5. Assembler - constructs the product.
6. Materials Manager - obtains the necessary supplies.

ADVERTISING/MARKETING

All members of the advertising group must be engaged in the planning of the advertisement and the product's marketing campaign. Specific responsibilities for each role are listed below.

1. Writer/Designer - utilizes computer technology to create the script and graphics for video advertising.
2). Salesperson - must have sound product knowledge and communicate product information to prospective customers.
3. Talent - promotes or endorses the product on screen by reading cue cards and following directions.
4. Editor - prepares script for public presentation.

VOCABULARY

Teaching the vocabulary will help create a common background for your students. You may wish to add terms to this list when appropriate. It is helpful to have this vocabulary posted or available for quick reference.

Advertising
Appeal
Association
Audio tape
Bandwagon
Brainstorm
Camcorder
Computer hardware
Computer software
Conformity
Crew
Cue
Disk
Edit
Endorsement
Evaluate
External microphone
Graphics
Hypothesis
Intellectual
Internal microphone
Multimedia
Propaganda
Publish
Scanner
Script
Shoot
Snob
Storyboard
Testimonial
Video tape

VIDEO TAPING

The entire class needs to be instructed on the proper care, set up, and break down of video and sound equipment, as well as the operation of a sound stage.

1. Use of camcorder (e.g. turn on/off, lay down magnetic tracks, color bars, white balance, pan, wide angle, close up, fade, and zoom).
2. Use of internal and external microphones.
3. Operation of video cassette player.
4. How to read a storyboard for camera cues and camera position prior to shoot.
5. Use of a narrative
6. Importance of practice sessions prior to shoot.
7. Need for review, critique, and editing.
8. Operation of editing deck (if available).
9. How to follow script and storyboard for video production.

PROBLEM SOLVING

It is imperative that students be aware of the problem solving process. It is of the greatest importance that students not isolate this concept within the confines of the classroom. Problem solving must be incorporated with a student's entire world. The following problem solving method is easy to understand and implement.

1. Identify problem
2. Gather information
3. Brainstorm possible solutions
4. Select most appropriate solution
5. Evaluate solution
6. Take action

MARKETING

Propaganda techniques should be introduced and reviewed so that various persuasive tactics may be employed in the video advertisement. Use of these techniques will help make students aware of demands put on them by the media and to become more intelligent consumers. These techniques should include:

- personal testimonials
- bandwagon
- snob appeal
- sex appeal
- intellectual appeal
- having fun

Computers are the means of communicating the ideas of the advertising campaign. Students will need to learn to use computer hardware. Computer word processing and desktop publishing programs help students create video advertising campaigns, banners, posters, signs, credits, and other graphics.

Students may use the computer to write a script. The script should contain instructions for audio as well as video taping in a form usable by the camera person during a shoot.

The storyboard is based on the script and depicts in words and graphics the details of each scene. Cue cards, developed from the script and story board, give specific lines to the talent in front of the camera.

SAMPLE PROBLEM

We have a garden that is exactly thirty meters from a water faucet. We only have ten meters of hose. A means of getting water from the faucet to the garden must be devised. The consumer will buy the best solution for the money.

Students are presented with this problem. Each team must compete for the job. After they have created a solution and are ready to market it, they are to sell this product to other classes.

When this activity is finished you might want to discuss the relationship of this problem to Arizona's limited supply of water. Located in the Sonoran Desert, Arizona has a great need for water. Oregon, however, has an abundance of water. Questions you might want to pose to the class may include the following:

- How could Arizona obtain Oregon's excess water?
- Is there really an excess?
- Would any transfer of water be fair and just to the people of Oregon?

SIDE TRIPS

Each team writes newspaper articles/journal entries as to their status. This would serve to keep all members of the team, as well as the population in general (other classes), informed as to the progress being made towards each invention and the marketing of it.

VIDEO SCRIPT

Director____

Production______________________________________

Date____

Video Instr	Audio Instr

VIDEO EDIT PLAN

Tape Number________________________ Page______________________

Production_________________________ Date______________________

___________________________________ Director__________________

Camera person______________________ Editor____________________

Time In	Counter	Description	Notes

VIDEO STORYBOARD

Production
Title____________________

Director____________________

Scene:____________________

Scene:____________________

CONCLUSION

One definite advantage to this activity is the manner in which concepts are presented to the student. Rather than being taught in isolation, concepts are introduced in a meaningful environment. These concepts are brought to life and experienced in a 3-dimensional format. Through science, the technology is created to solve a problem for society. The technology is marketed to the public in a way that will get their attention and serve their needs, and besides it's fun.

WHAT DOES YOUR FUTURE HOLD?

(Grades 4-8)

By Vanessa Salas

INTRODUCTION

Who could have guessed fifty years ago that we would be able to cook food in seconds, or make videos of ourselves? Most people would never even have thought of using a computer to play music for them or owning a car that doesn't use gas. Our world has seen many fascinating changes throughout the years.

Throughout, centuries people have been making predictions about the future. The future is a mystery that can only be solved with time. This unit was developed to help students think about the unlimited possibilities that their future may hold.

GETTING STARTED

This unit can be used with students in grades 4-8. The students will also need magazines and books about the future. A suggested list of reading materials is included in this article.

FIRST WEEK

During class discussion about what life was like in the 1900's, have the students list all the changes and inventions that have occurred since the 1900's. For example, the color television, the beginning of space travel and the discovery of atomic energy. When the students have completed their lists, divide them into groups of four. The students will research predictions about the future that were made long ago by scientists and inventors. A good article to start with would be one by Charles P. Steinmetz's entitled, "You Will Think This a Dream, A 1915 Vision of Tomorrow " that can be found in the September 1915 issue of The Ladies Home Journal, or in the book entitled, 1999: The World of Tomorrow, published in 1978 by the World Future Society. After all the groups have completed their research and have found at least one article or book on predictions, they will choose someone from their group to read their selection to the class. After listening to all the groups' selections, the class will then discuss which predictions came true, and which ones did not.

SECOND WEEK

During the second week of this unit, the students will study what science fiction is like today. In their small groups, they can read excerpts from books or magazines about the future. They can also watch movies about the future such as "Star Trek" or even cartoons like "The Jetsons®".

THIRD WEEK

After studying all the possibilities for the future, the students will begin to make their own "Book of Predictions". This book will include future cities, homes, transportation, careers, communication and education. Their books should include a one page explanation and description for each of these chapters or topics. Each chapter/topic will also need an original illustration. When the students have completed their books, they will make covers and bind them together. They will then read their books to the class.

FOURTH WEEK

As a conclusion to this unit, the students will do some creative writing. Each student will write a story about what a normal day would be like in the year 2015, from the time they wake up until the time they go to sleep. When they have completed their creative writing assignment, they will share it with the other students in their group or with the whole class.

This unit provides students with an opportunity to use their researching and writing skills and the chance to work cooperatively with other students.

SUGGESTED LIST OF RESOURCES FOR THE FUTURES UNIT

BOOKS

1) A Child's Library of Dream by Sheri Clyde
2) Are There Alien Beings? The Story of UFO's by Gerald Snyder
3) Careers Tomorrow: The Outlook for Work in a Changing World edited by Edward Cornish
4) The City in the World of the Future by Hal Hellman
5) Communications Tomorrow: The Coming of the Information Society edited by Edward Cornish
6) The Computerized Society: Living and Working in an Electronic Age edited by Edward Cornish
7) Education and the Future edited by Lane Jennings and Sally Cornish
8) ESP: Your Psychic Powers By William Akins
9) Fahrenheit 451 by Ray Bradbury
10) Is There Life in Outer Space? by Robert Kraske
11) The Kids Whole Future Catalog: A Book About Your Future by Paula Shore
12) 1999: The World of Tomorrow Selections from THE FUTURIST: A Journal of Forecasts, Trends, and Ideas about the Future edited by Edward Cornish
13) The Omni Future Almanac edited by Robert Weil
14) Profiles of the Future: An Inquiry into the Limits of the Possible

by Arthur C. Blake

15) Sixth Sense by Larry Kettlekamp
16) The Study of the Future: An Introduction to the Art and Science of Understanding and Shaping Tomorrow's World by Edward Cornish
17) Teaching About the Future Tools, Topics, and Issues by John D. Haas
18) 2010: Career Sourcebook Two: Living and Working in the Twenty-First Century by Raynor Cannastra Associates
19) Why Does a Turtle Live Longer Than a Dog? by Barbara Ford

MAGAZINES

1) The Futurist: A Journal of Forecasts, Trends, And Ideas About the Future
2) Futures Research Quarterly
3) Omni

MOVIES

1) Aliens I-III
2) Back to the Future I-II
3) Dunes
4) H.G. Wells-The War of the Worlds
5 Teminator I-II
6) THX 1138
7) Time Machine
8) Total Recall
9) 2001 Space Odyssey
10) Sleeper
11) Soylent Green
12) Star Trek I-VI
13) Star Wars

EXAMPLES OF CHAPTERS/TOPICS FOR THE "BOOK OF PREDICTIONS"

CITIES

1) Floating Cities (Air and Water)
2) Dome Cities
3) Space Colonies
4) Underwater Cities

HOMES

1) Computerized Houses
2) Living Houses
3) Underground Houses

TRANSPORTATION

1) Air Cars
2) Coast-to-Coast Speed Trains
3) Human Powered Flight
4) Hydrogen Powered Cars
5) Super Cycles

CAREERS

1) Bionic-Electronic Technician
2) Genetic Engineer
3) Holographic Inspection Specialist
4) Robot Production Technician

EDUCATION

1) Moving Schools(Ships and Planes)
2) Learning While Sleeping
3) Robot for a Teacher

COMMUNICATION

1) Electronic Language Translator
2) Multi-screen TV
3) Video Telephones

WIND EROSION

(Grades K-6)

By Rhonda Gross

INTRODUCTION

Think Globally, Act Locally. Reduce, Reuse, Recycle. Save the Spaceship Earth. School children are bombarded with ecological jargon at school, in the media, and at home. This glut of conservational messages has produced some results. The local newspaper recently reported that Americans now recycle 50% of all aluminum cans. That's great! However, I often wonder if we have failed to demonstrate to our children, using logical non-emotional methods, the importance of all this environmental bruha-ha. If we don't provide genuine opportunities for knowledge-based analysis of real ecological issues to our young people, I fear that the conservation movement will go the way of the passé Teenage Mutant Ninja Turtles® fad and other media blitz campaigns. Students should be given examples of real environmental issues and allowed to formulate their own future plans of action.

Objectives:

Students will . . .

1. Identify the reasons why we dig up the earth using strip-mining techniques
2. Hunt for silver in "Geological Jello"
3. Consider why we should restore strip-mined areas
4. Conduct an experiment to prevent wind erosion
5. Draw a pictograph
6. Formulate a conclusion about which materials best prevent wind erosion

ACTIVITY ONE

Materials:

Common items that are made of materials mined from the earth such as:

(a) A diamond ring
(b) Copper penny
(c) Quart of motor oil
(d) Steel shaft
(e) Lump of charcoal etc.

Procedure:

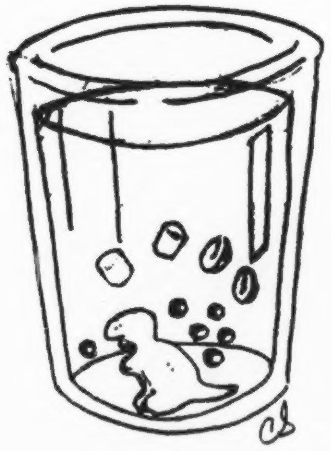
Display all of the items whose raw materials were mined from the earth. You might want to hold up or pass several around. Ask the class if they can tell you what all of these things have in common. Write all suggestions on the board. Lead the class to agree that all of the items came from the ground. Explain to the class that many things are dug up from the ground. "Gold, diamonds, silver, are some examples of things dug up from the ground. People want metals and gems since they are considered valuable. People pay a lot of money for things that were once buried in the earth. Some people dig up the earth to find silver, gold, or other valuable things. They sell the valuable things they have dug up, to people who want them, and use the money to buy what they want." Ask the class if they think that it is right for people to dig up pretty and useful things from the earth. Usually the students will all agree that it is fine for people to do that.

ACTIVITY TWO - EXPLORATION

Materials:
(a) Geological Jello for 30 students
(b) 8 ounce paper cups
(c) Paper plates
(d) Plastic spoons
(e) One napkin for each student
(f) 4 large boxes of red jello (to represent dirt)
(g) Marshmallows (to represent rocks)
(h) Nuts (to represent limestone)
(i) Dinosaur cookies (for fun)
(j) Small package of silver cake topping beads (to represent silver ore)

Procedure:

Mix the jello according to the direction on the package, cool for about 1 hour so that it is just starting to set. Place a dinosaur cookie in the bottom of each cup, and pour 1/2 inch of jello over it. Sprinkle 2 teaspoons of silver cake topping beads on top. Then add in layers marshmallows, nuts and the rest of the jello. Let it sit overnight.



GEOLOGICAL JELLO STRIP-MINING

EXPLORATION

Pass out a cup of Geological Jello, paper plate, napkin, and plastic spoon to each student. Instruct them to dig up their jello very carefully, layer by layer. Don't tell them what they are looking for, just that they are mining. They will find the mother lode of silver, but they have to sort through the rocks and dirt to mine it. They need to separate the silver beads from the other debris and place them on a paper plate. They are not to eat the jello yet.

EXPRESSION

Tell the students to look at their work area, and ask them if it is very clean. Encourage them to comment on the mess, and ask if they should clean it up. Ask one student how he or she would feel if he or she had to clean up everyone's mess. Question them on what their mother would say. She would say, "clean up your own mess". Write this on the board, CLEAN UP YOUR OWN MESS. Remind your students about how they had agreed that it was alright to dig up the earth. Then ask if it is still fine even if it results in a horrible mess. Allow time for discussion and for the students to eat their jello.

ACTIVITY THREE - LABELING

Strip-mining is used to extract gold, silver, coal, copper, and several other valuable resources from the earth. Explain that digging up Geological Jello and sorting out the silver beads from the marshmallows and nuts is very similar to strip-mining. Also point out that many mining companies don't listen to their mothers and don't clean up their own messes. They leave behind huge piles of ugly dirt. A strip-mining video from the school media center might provide a good visual example.

"Wind and water take the dirt off the top of the pile and spread it all over the country side. The dirt goes into the air and pollutes it, into peoples' clothes, washes into highways, and looks ugly. Ask if any of the students have seen the wind blowing the dirt around. When wind blows the dirt from place to place it is called wind erosion. Because many people don't want to look at ugly hills of dirt caused by strip-mining, mining companies are finding ways to clean up their messes."

Have the class suggest ways to stop wind erosion. They may suggest covering the hill with a big tarp, gravel, planting trees or grass, spraying water on it, or laying asphalt over it.

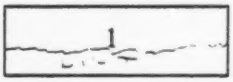
ACTIVITY FOUR - APPLICATION:

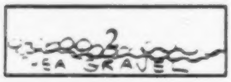
Materials:

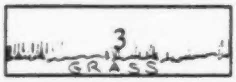
(a) 3 flat cardboard boxes (such as the ones that hold 4 six packs of pop)
(b) 10 pound bag of potting soil
(c) Scale (postal scale works well)
(d) 6 inch by 8 inch area of dug up grass
(e) Pea gravel(usually found on the playground)
(f) Fan and extension cord
(g) Safety goggles

Procedure:

Have the students pour 2 pounds of potting soil into each of the boxes, weigh and record each of them. Set box #1 aside. Add pea gravel to the top layer of dirt in box #2, and weigh and record its weight. Spread the grass on top of the dirt in box #3, and weigh and record its weight.

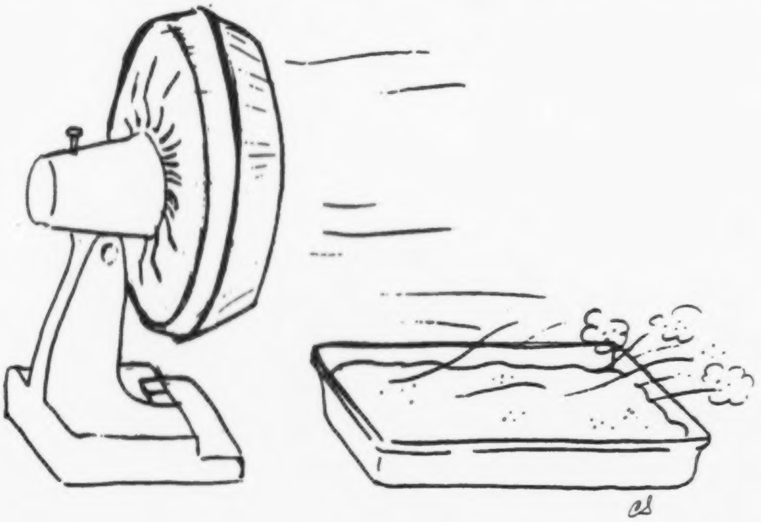




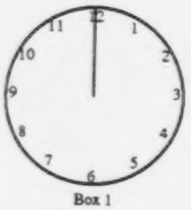


Take all three boxes outside. Point the fan turned onto high speed towards box #1 and let it run for 5 minutes. Weigh and record the box afterwards. Blow the fan on box #2 for 5 minutes and weigh and record. And finally blow the fan on box #3 for 5 minutes and weigh and record. If you allow the students to conduct this experiment be sure that they wear safety goggles when the dirt is blowing around.

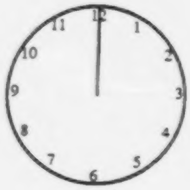
Younger students may have a difficult time grasping the data analysis of this experiment. If subtracting the weight of the grass, pea gravel, or trying to explain the loss of dirt by wind erosion using fractions or decimals may be beyond the younger students comprehension. I recommend that you use the following example instead, or draw a worksheet with three faces similar to the scale that you used to measure the dirt in the experiment.



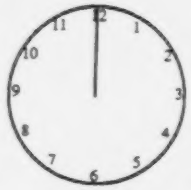
Write box #1 under the first face, box #2 under the second and box #3 under the third face.



Box 1

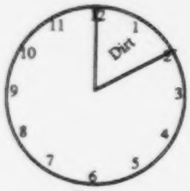


Box 2

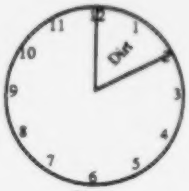


Box 3

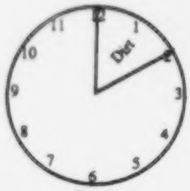
Draw a large example of the worksheet on the board. Give each student a copy of this worksheet and have them find 12. Then ask them to use a brown crayon and mark the 2 pound number on all three faces on their paper.



Box 1

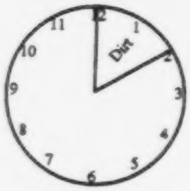


Box 2

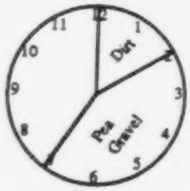


Box 3

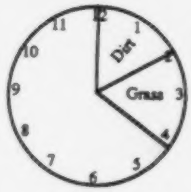
Instruct your students to use a blue crayon to mark the face of box #2 at the number for the combined weight of pea gravel and dirt. Have them use a green crayon to mark the combined weight of the grass and dirt on the third face



Box 1

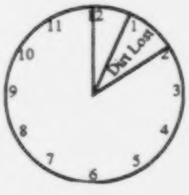


Box 2

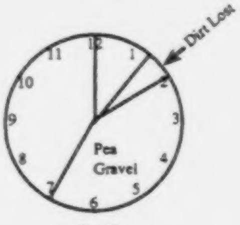


Box 3

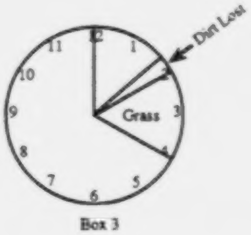
Tell the class what the weight of box #1 was after the wind had blow on it for 5 minutes, and have them mark that weight in pencil on the face of box #1. Give the final weight of box #2 and box #3 and record these in pencil on their worksheets. Instruct them to look at their worksheet and use a brown crayon to color in the difference between the weight of each box before the wind blew and the weight of each box after the wind blew.



Box 1



Box 2



Box 3

Ask them which box has the biggest brown-colored area. State that the brown is the dirt that was blown away. Have students identify which box lost the most dirt due to wind erosion. The students should now be able to conclude which material best prevents wind erosion. The teacher might want to expand on this and discuss which materials would look nicer, the cost effectiveness of certain materials, or alternative mining techniques.

ACTIVITY FIVE - ENCOURAGING STUDENTS TO TAKE ACTION

With their new found knowledge some students may be motivated to take a broader action concerning strip-mining or other related environmental issues. The teacher might want to suggest to those students one of the following plans for active involvement.

1. Interviewing a geologist, an executive within a local mining company, or a member of an environmental activist group.
2. Transferring their new found knowledge to students in other classrooms through a demonstration, play, or storybook.
3. Surveying the teachers and staff of the school concerning their views on local environmental issues.
4. Starting or participating in a neighborhood cleanup campaign.

ABOUT THE AUTHORS

Linda Begalman earned her bachelor's degree in history and secondary education from Adelphi University in New York. She presently teaches 7th and 8th grades at W.R. Sullivan School in Phoenix, Arizona.

Chuck Collins teaches 8th grade life science at Creighton Middle School in Phoenix, Arizona. He earned his bachelor's degree with honors in economics from Loyola University in Chicago. Chuck writes under his Irish name **cahal o'coileain**.

Gerald W. Dameon currently teaches at T.G. Barr Computer Assisted Resource Education School. He has over 16 years of teaching experience in grades 4 through 8. He has developed numerous lessons and units.

Douglas A. Freeman received his teaching degree in special education, with a minor in Spanish, from Eastern Michigan University. He teaches science and bilingual education at Jack L. Kuban School in Phoenix, Arizona.

olivia free-woman has been performing in the classroom since 1974 and currently teaches at Creighton Middle School in Phoenix, Arizona. She states, "The classroom is a great stage and your audience only occassionally walks out on you."

Valerie Grimes has been teaching 4th grade at William T. Machan school in Phoenix, Arizona since 1987. She graduated summa cum laude from Arizona State University with a bachelor's degree in elementary education.

Rhonda Gross received her bachelor's degree in elementary education from Grand Canyon University. Her greatest teaching goal is to convey to students and fellow teachers an appreciation for science and for God's creations.

Sandra J. Israel, a special education resource teacher at W.R. Sullivan School in Phoenix, Arizona, graduated cum laude from Arizona State University with a bachelor's degree in psychology. She also holds a master's degree in special education.

Teresa Olson earned her bachelor's degrees in education and psychology from the University of North Dakota. She currently teaches 6th grade at Monte Vista Elementary School in Phoenix, Arizona. Her hobbies include reading and various types of crafts.

Susan J. Perez holds a bachelor's degree in elementary education from Arizona State University. She has been teaching bilingual education at C.J. Jorgensen School in Phoenix, Arizona for the last six years.

Lynn Piwowarczyk earned her bachelor's degree in education from Central Michigan University. She teaches 5th grade at T.G. Barr Computer Assisted Resource Education School in Phoenix, Arizona.

Vanessa Salas graduated from the University of New Mexico with a bachelor's degree in elementary education with a minor in psychology. She has taught grades 4 through 7 and currently teaches at C.J. Jorgensen School in Phoenix, Arizona.

STS PROJECT
College of Education
Arizona State University
Tempe AZ 85287-0911
(602) 965-3133

BEST COPY AVAILABLE